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Current Science

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The Educational Advisory Board.

THE formation of a Central Advisory Board of Education, foreshadowed by Sir G. S. Bajpai at the last session of the Legislative Assembly at Delhi, is, in our opinion, an urgent necessity. In recent times, the academic problem has assumed new and perhaps complex shapes, and in its solution the Government of India might naturally desire to rely on the advice and assistance which this expert body is competent to place at their disposal. When Government abolished the Bureau of Education in 1923, their influence on the formation and execution of the educational policy of provinces practically disappeared and the new Board is obviously intended to restore that influence. It is desirable—means will no doubt be found for it—that the Educational Advisory Board should be so constituted that it will fit into the general framework of Federal Administration, since it is proposed to make it a department of Central Government. Otherwise the experience and progress obtained by the Indian States in the sphere of education will lose contact with the machinery devised for British India. Educational progress in India is hampered by periodic financial inhibitions, and the first task of the Board must be to secure a statutory grant for giving effect to its recommendations.

Among the various factors which have rendered the academic problem increasingly complex in India, mention must be made of the immense expansion of scientific knowledge with its reactions on the social and economic life of the country, the vastly increased demand for higher and technological education, the wider conception of the duties of the modern universities and the emergence in the body politic of social communities which had previously remained indifferent. We are not impressed by the zeal of educationists for the constitutional reform of their institutions, however important they may be to the inner life of their administration, for the outside world always measures the efficiency of the machinery by its results, unmoved by its structural beauty. The problem of the public is comparatively simple. The man in the street

desires to enter his sons for his own professions or aspires to give them access to the public service of the country. To a matter-of-fact person, the ideal of knowledge for its own sake has few attractions, and his greatest concern is that the money he invests in the education of his children should bring return in the form of enrichment of his own profession, or that their service to the State should be adequately remunerated. Such a man has very little use for the type of education now imparted in our schools and colleges, which in his judgment leads nowhere. One of the criticisms passed on modern education is that the cultural and social advantages of higher education are beyond the reach of the man of humble means. Of all the questions which will engage the earnest and immediate attention of the projected Board, the most important ones appear to us to be the statutory grant, the education of the poor man's children and the problem of the pass-man.

The Government of India contemplate the creation of a number of Committees to assist the Advisory Board in the investigation of relevant problems, and perhaps the most vital question that will confront the Board, when brought into being, must relate to Finance. There should be established a Committee of Finance of moderate dimensions, of independent character and possessed of adequate powers to act as a link between Government and the Board. We would prefer to call this body, Committee of Reference. It should enjoy statutory power for the purpose of elucidating and correlating expenditure on the several grades of education, besides exercising advisory and supervisory authority in connection with the financial allocation in each province. The advice of this Committee in regard to the assignment of contributions by the Central and Provincial Governments to educational and university purposes should be adopted, which would thus secure unification of the financial policies of the different administrative authorities. If such a body is to be efficient it must include independent men of affairs, who could pronounce impartially upon conflicting claims, and also persons who are cognizant of the needs and general practice of the universities and have a genuine interest in their welfare and progress. We emphasise the importance of the Committee of Reference because it is borne in upon us that the clue to the majority of the educational and university problems and the condition of their reforms must ultimately be finance, and unless the Committee secures adequate statutory financial contribution, progress will be impossible.

It is obvious that since the appearance in the political field, many of the social classes in India are anxious to participate in the benefits of higher education, to which they are attracted as an instrument in the task of preparation for their new and arduous responsibilities. They regard higher education as an indispensable equipment for the part that they desire to play in national life. The extension of the franchise, the increasing association with local self-governing bodies and the organisation of social groups have given them power which they rightly think they can exercise for the advantage of their own class and also for that of the nation, if this power is accompanied by knowledge. Our schools and colleges are now filled with the sons of these social classes, because they think that they have a right to share in the national cultural inheritance, and it is appropriate that special facilities and preferential treatment should be offered to them. But in recent times, the discussion of the question of creating special advantages for them has suffered from the defect that little or no attempt has been made to distinguish between the various classes among whom the term "poor" is treated as synonymous with that of "backward". We attribute the failure of some modern educational expedients aiming at reform, to this confusion of ideas, and the fact is that plans suitable to one section have been found almost inapplicable to the other. The changes in the economic life of modern society and in the intellectual progress of the nation necessitates a more scientific distinction of the communities; for the wage-earning classes who could properly have been called "poor" half a century ago have now acquired wealth, while those who may fairly be termed "backward" did not at that time aspire to higher education. But in so far as both of them represent particular strata in the national life, it is obvious that they should have free access to the advantages of higher education.

Perhaps the most delicate and difficult task for the Advisory Board will be to formulate their proposals for the working-class education, to encourage the desire of the industrial communities to profit by

academic discipline. If this desire is genuine, then it seems to us that its satisfaction should not exclusively be left to private enterprise or to a somewhat precarious combination between state and municipal interests, but that it should be recognised and regulated by the Board or by one of its Committees. Should there be a working-men's school and college in every important industrial centre, where education is imparted free of cost? In answering this question, it should be borne in mind that gratuitous benefactions do not promote a sense of self-respect, nor is their value fully appreciated. For the creation of such institutions for the children of humble means, the Board must seek and find assistance from public-spirited benefactors to supplement its other resources. Education is a slow process and naturally therefore it does not excite popular imagination or stir public sympathy. The recent enhancement of school and college fees and dues, owing largely to the shrinkage of grants to these institutions has placed impediments in the way of poor young men who wish to take their share in the academic and social advantages of higher education. If in spite of subsidies in pecuniary or other shapes which the poor disappointed young men might otherwise obtain, there are features in the higher general and professional institutions, which act as a deterrent to the entry of such students. We do not subscribe to the theory that education is meant only for those who have sufficient means and intelligence to profit by it. If a man is sufficiently rich he is often indifferent to education. The purpose of education is to seek those whose intellectual powers are dormant and to stimulate them for the advantage not only of their own class but also for that of the nation. The problem of educating the poor is a national task to which the proposed Advisory Board must give serious attention.

In the way of broadening the avenues for the admission of wider classes to the benefits of higher education, we are met with two problems, *viz.*, examinations and pass-men. If it could be proved that examinations by the qualities that they test, are a valuable adjunct to a young man's education, we might face all the unsparing criticisms which the public heap upon them. Examinations are jumbled together with an uncertain multiplicity of standards with neither consistency nor uniformity. A man who is rejected in one college or university may obtain admission to another where he may pass with honours. This is a question which no scheme of reform undertaken by the Central Advisory Board can overlook, and which cannot be permanently ignored.

The question of examination in the last resort raises the issue of the pass-man and of his position in the field of higher education. We have no concern here with the pass-man whose idleness is responsible for his poor academical achievements but we have every consideration for the other type of pass-man whose honest endeavours have resulted only in very modest performance. It should be remembered before judgment is pronounced on such a student, that he is entirely ignorant of his own mental capabilities. He has inherited these and education cannot replace them, but can only polish them. It is ignorance of this fundamental fact that must account for all the denunciation of these young men and for opinions frankly expressed that the standard of higher education should be sufficiently stiffened to exclude them from its advantages. The Universities have obviously no use for such young men, and the employer passively accepts the verdict of the academic bodies in considering his employability. It seems to us that this judgment is as harsh and hasty, as his rejection is unsound and unwarranted. If the Universities expend their energies and resources on the creation of an intellectual oligarchy, then they cease to be national institutions, and may have to forfeit their claims to be supported by national revenues.

A great injustice is perpetrated when the idle pass-man is taken to be the type of the pass-man in general, and when the sins of the individual are visited upon the class. We shall cheerfully accept the reproach of being Philistine or reactionary, if we can succeed in impressing upon the public mind that the first concern of higher education is to instruct and enlighten the pass-man. If our universities are to continue to deserve public support, they have few more important duties to perform than to give a good general education to the man of poor capabilities. To convert him into an enlightened and useful public servant is as honourable a task of our educational institutions as it is to discover and foster eminent talents, and it is a fact that many of the men, who in later life have reflected the greatest credit on their education, have been those who never took more than a pass degree. We do not believe

in the soundness of the argument that the universities are exclusively for brilliant men, for we do not see any reason why pass and honours men should not exist side by side. We conceive that it is in such co-existence and happy mingling of all talents and social qualities favouring good fellowship and toleration, that the service of the universities to the nation resides.

The Educational Advisory Board when it deals with the question of reforming the educational system in India, will be confronted with the difficult task of framing suitable proposals for educating the poor man and the pass-man, and the task, however difficult, must be satisfactorily solved.

"Science and Culture."

WE have pleasure in offering a warm welcome to *Science and Culture*, a new monthly journal of natural and cultural sciences, the first issue of which has reached us by the courtesy of the editor, and whose aim is to promote the cause of science by spreading scientific knowledge among the public. It is further explained that publication is promoted by a non-profit corporation of "some eminent scientists and educationists of India," whose identity will doubtless be revealed in a subsequent issue.

The subject-matter is varied and interesting. Following an editorial introduction which rapidly sketches outstanding events in the historical development of Indian civilisation, there comes a long and informing article on "Bengal Rivers and their Training" by Dr. N. K. Bose, who wisely advocates establishment of a river physics laboratory resembling those already operating in Western countries, where schemes connected with river-control may be tested before adoption. An article on the "Ultimate Constituents of Matter" by Professor M. N. Saha deals comprehensively and lucidly with modern views of atomic architecture, and concludes with an imposing list of the fundamental particles involved. Rai Bahadur Ramaprasad Chanda, under the title "Aryan, Indo-Aryan and Dravidian" traces the various authorities for different forms of *bhakti*, while "Some Reactionary Consequences of Psychoanalysis" are indicated by Col. Owen Berkeley Hill. A short contribution on "Susruta and Early Hindu Anthropometry", by Dr. Panchanan Mitra is followed—abruptly as it may seem to some readers—by "Safety of Electric Installations in India" from Professor B. C. Chatterjee.

Other features are book reviews, obituary notices, a full description of the Indian Statistical Institute's foundation and purpose, a report of the U.P. Academy of Sciences April meeting, and letters to the editor. Support is given to the view of Lord Rutherford as expressed in his letter to *The Times* dated April 29, 1935, concerning retention of Professor Kapitza by the Soviet Government, and a useful outline of the distinguished captive's technical ingenuity is presented. Treatment of the subject would have gained piquancy—and perhaps proportion—if Lord Rutherford's contribution had been supplemented by the letter of Professor H. E. Armstrong, who considers that the restoration of Professor Kapitza to his homeland, so far from being a calamity, is merely a blessing in fancy dress; but then it must be remembered that this chemical veteran on a recently previous occasion stoutly opposed himself to the principle of imported professors.

From this brief survey it will be recognised that *Science and Culture* covers a wide range of material, and incidentally it may be stated that the printing and paper are excellent. It remains to consider whether the treatment of the subjects chosen is calculated to achieve the declared purpose of the promoters, namely, "dissemination of scientific knowledge amongst the public". A rough classification of the literate public in relation to scientific knowledge would reveal two main groups, namely, specialists in one or more branches, and a generally well-informed public whose members desire to keep themselves aware of such scientific discoveries and principles as may be assimilable without previous training in science. *Nature* and the *Scientific American* are probably the best known journals appealing to these two groups, respectively, and throughout the past three years we have consistently endeavoured to meet the needs of the former group in this country, with strict avoidance of partisan or territorial bias. Some aspects of *Science and Culture* are so similar to the corresponding features of *Current Science* that we confess to misgiving that its promoters have judged us and found us wanting. Actually, there is very little of the material presented in this first issue for which we would not gladly have

found space in our own columns. The question therefore arises in our mind, is there a large enough public for two similar journals; because, if not, we fear that both must languish, under-nourished in both material and support. On the other hand, there is ample room for a journal popularising science, old and new. Therefore, while welcoming *Science and Culture* we take leave to hope that future issues may devote themselves more definitely to the declared policy of its promoters, and expand on lines complementary to—rather than competitive with—*Current Science*.

Nation Building and Scientific Research.*

EARLY during the Great War, in 1915, His Majesty's Government formed a Committee of the Privy Council for Scientific and Industrial Research, who were entrusted with the task of establishing a close link between science and industry. In the course of the next two years, this organisation developed into the Department of Scientific and Industrial Research under whose auspices a great number of researches of national importance are being carried out. The researches have an intimate bearing on some aspect of national life or industry. The cost of these investigations is being borne by co-operating firms in an ever-increasing measure, thereby showing that industry is appreciating the value of scientific research. The design of ship's hulls, the effect of waves on the resistance and pitching of ships, effect of wind resistances, the behaviour of rudders and the improvement of propellers —all problems connected with the national industry of shipping, are being investigated. The Building Research Station is conducting investigations on the design of steel frame buildings, on methods of increasing the resistance of concrete and mortar to chemical attack, on heating and ventilation problems, on limes, bricks and clays and on cast concrete products—problems closely connected with the life of the nation. The Department has also interested in the development of new high temperature alloys, in discovering new outlets for low grade coals and in the problems of storage and transport of fruits, vegetables, fish and meat, which are of vital importance in securing an adequate supply of wholesome food for the nation. Interesting work seeking an answer to the question "why does one flour from one kind of wheat produce better bread and dough than another?" is being done by the Flour Millers' Research Association. The National Physical Laboratory is largely concerned with testing and standardisation of products manufactured by industrial concerns. The Leather Research Association, the Paint Research Association, the British Scientific Instrument Research Association, the Food Manufacturers' Association and other Research Associations are all co-operating with the Department of Scientific and Industrial Research in a programme of Nation-building acitvity, to the great advancement and prosperity of the nation as a whole.

M. S.

* Report of the Department of Scientific and Industrial Research for the year 1933-34.

The Artificial Preparation of the Male Sex Hormone.

By Professor L. Ruzicka,

Technical High School of Zurich (Switzerland).

THE male sex hormone may be defined as a chemical compound produced in the testicle, and which in the male organism promotes the growth and function of the sex organs and glands, and also the development and maintenance of the secondary sex characteristics and sex instinct. The discovery of this hormone resulted from successful experiments on castrated male animals, in which the atrophy of the sex characteristics and organs was cured by implantation of the testicles of other adult animals. The first experiments in this direction date as far back as 1849, *i.e.*, long before there existed a science of hormones, when Berthold (Göttingen) successfully implanted fresh testicles into capons.

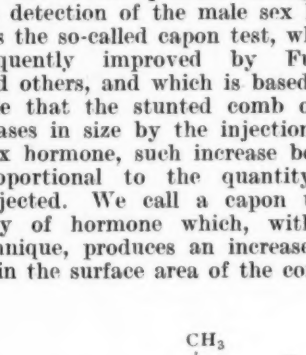
In 1929 Gallagher, Koch and Moore (Chicago) succeeded for the first time in preparing a really effective testicular extract which exhibited, in castrated animals, effects similar to those formerly obtained by grafting fresh testicles. These investigators also worked out the first practical biological test for the detection of the male sex hormone. It is the so-called capon test, which was subsequently improved by Funk, Laqueur and others, and which is based on the principle that the stunted comb of a capon increases in size by the injection of the male sex hormone, such increase being roughly proportional to the quantity of hormone injected. We call a capon unit the quantity of hormone which, with a definite technique, produces an increase of about 20% in the surface area of the comb.

With the help of this method, Butenandt (Göttingen) isolated in 1931 a male sex hormone in crystalline form from the urine of men; the injection into a capon of 0·3 to 0·4 milligrammes of the said hormone, in fractional doses, in the course of a few days produces a 20% increase in the surface area of the comb. The isolation of this hormone, called androsteron, is extremely laborious and up to the beginning of 1933 only 25 mg. of it had been isolated, for which quantity 50,000 litres of urine were required. Butenandt was able to establish that androsteron is a saturated oxyketone having the formula $C_{19}H_{30}O_2$ or $C_{16}H_{28}O_2$, and possessing four rings, although an exact chemical investigation was not possible at that time owing to the difficulty of obtaining sufficient quantities of the hormone. It was, however, possible to form a hypothetical picture of the probable structural formula of androsteron on the basis of the knowledge of the follicular hormone (theelin, œstrin) acquired in the meantime.

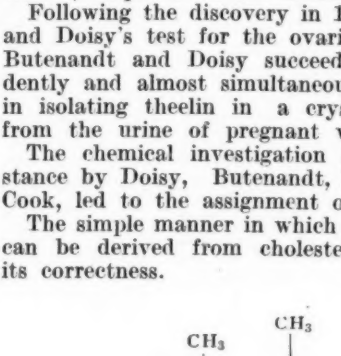
Following the discovery in 1923 of Allen and Doisy's test for the ovarian hormone, Butenandt and Doisy succeeded, independently and almost simultaneously in 1929, in isolating theelin in a crystalline form from the urine of pregnant women.

The chemical investigation of this substance by Doisy, Butenandt, Marrian and Cook, led to the assignment of formula I.

The simple manner in which this formula can be derived from cholesterol supports its correctness.



I
Theelin



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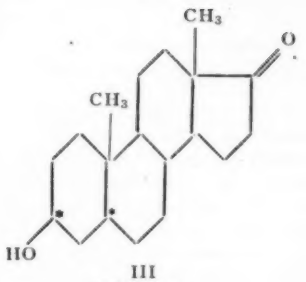

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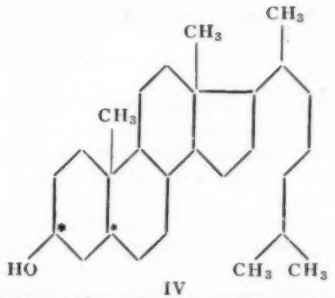
Androsteron



IV
Dihydrocholesterol and stereoisomeric sterols

It is only necessary to consider that the terminal six ring of cholesterol is dehydrogenated with the formation of a phenol ring, and further, that the long side-chain is completely split off by oxidation with the formation of a ketone group.

Assuming that androsteron is also derived from cholesterol, the formula $C_{19}H_{30}O_2$ leads to the structural formula III which Butenandt proposed in 1933, as an intermediate product in the course of the hypothetical conversion of a hydrogenated sterol into theelin. The formation of a substance corresponding to formula III from hydrogenated sterol, requires only the splitting off of the long side-chain, in the same way as theelin is considered to be formed in the body by the oxidative degradation of a dehydrogenated sterol.

In view of the great difficulties which were to be expected in an attempt to determine the exact constitution of androsteron by entirely analytical methods, the author, together with his assistants, M. W. Goldberg, Jules Meyer, H. Brüngger and E. Eichenberger, decided to approach the question from another angle. An attempt was made to prepare the hormone artificially by following as closely as possible the method which nature probably uses for producing it in the body.

It was first of all necessary to investigate the question of the most suitable material to be used for the proposed work. We have discussed above the hypothesis of the derivation of theelin from cholesterol. However, up to now there are no facts at all showing that theelin is stereochemically identical with cholesterol. Further, in the artificial preparation of androsteron it was necessary to take into consideration the steric structure at the two positions marked with an asterisk in formula III. All hydrogenated sterols hitherto known differ one from another by a different steric position at these two carbon atoms. Four different stereo-isomers of the formula IV are known: dihydrocholesterol, epi-dihydrocholesterol, koprosterol and epikoprosterol. We have included all these stereo-isomers in our investigations. Before the splitting off of the side chain, the hydroxyl groups were protected by acetylation from the action of the chromic acid used as the oxidising agent. It must be emphasised, that according to the statements in the literature, it was very improbable that a ketone of the type of androsteron could result from the oxidation of an acetylated sterol corresponding to formula IV. This improbability has certainly deterred, up to now, other investigators from employing this exceedingly simple method for the solution of the problem of the male sex hormone. However, our optimism proved to be justified. By oxidation of the acetates of the 4 sterols named, we were able to isolate the corresponding 4 oxyketones. The oxyketone derived from epi-dihydrocholesterol proved to be identical in every respect, chemically, physically and physiologically, with the natural androsteron. On the other hand, the other three isomers are distinctly different from androsteron.

Although there was from the beginning a certain probability that androsteron might belong to the sterol group, no one could have expected that it was derived from epi-dihydrocholesterol. Girard, for instance, had considered the hypothesis of lithocholic acid being the mother-substance from which androsteron originates, while Butenandt thought koprosterol more feasible. No one had previously imagined the existence of a derivative of epi-dihydrocholesterol (or of epikoprosterol) in nature.

A comparison of the physiological action of the 4 stereo-isomeric oxyketones $C_{19}H_{30}O_2$ shows the importance of the steric

configuration for the hormone character. Whereas with androsteron (both natural and artificial) a capon unit amounts to 0·07 mg., one injection a day being made during six consecutive days, one unit of the oxyketone derived from di-hydrocholesterol is 0·5 mg. The two oxyketones derived from koprosterol and its epimer were ineffective in daily doses of 1 mg.

The synthetic preparation of androsteron permitted for the first time the complete elucidation of the constitution of a sex hormone. This is a rare case of the elucidation of the constitution of a natural product of intricate composition, by the artificial preparation of the substance before anything was known about the structure of the carbon skeleton.

In this case the method of elucidation was just the reverse of that usually employed: the first detailed publication of Butenandt on the chemical reactions of androsteron which appeared two months after our communication of the synthetic preparation contains no mention of a degradation product of androsteron which might have been identified with a compound of a known constitution.

The greater accessibility of synthetic androsteron permits the investigation of the question of whether there is only one male sex hormone, or if several compounds together are responsible for the effects observed. Butenandt has already discovered a second male hormone in the urine, dehydro-androsteron, which acts in the same manner as androsteron on the capon's comb, but is distinctly weaker. There are also several female sex hormones all of which, however, exhibit a weaker action than theelin. According to our present knowledge, theelin suffices for the production of the effects of the ovarian hormone. The results obtained up to now with androsteron do not contradict the assumption that it can exhibit all the effects which one expects from the testicular hormone. Let us now describe briefly the most important physiological investigations, which have been carried out by E. Tschopp in the "Ciba" Laboratories in Basle.

The capon test shows that an overdose of androsteron causes an exceedingly pronounced increase in the size of the comb. For example, by painting the comb (according to Fussgänger's technique) daily for ten days with a 1‰ solution of androsteron we observed that the surface of the comb was increased sevenfold.

Furthermore, painting with a 0·5 ‰ solution of androsteron, the site where later the comb grows on newly hatched chickens.....causes, after a few weeks, the appearance of a comb of approximately the same size as that of cocks having attained their full development.

From a clinical point of view, it is interesting to note that with capons in which too small a portion of testicle has been preserved for the stunted comb to be able to grow, temporary injections of androsteron cause a prolonged growth of the comb. In completely castrated capons, on the contrary, the comb stops growing on cessation of androsteron treatment, whereupon a gradual atrophy of the comb to its initial size takes place. Such effects have already been observed following the administration of testicular extracts. In certain cases of testicular hypofunction, androsteron can act as a "hormone fillip" to stimulate the inactive generative glands into new activity. Investigations with mammals in that connection will be of great importance.

Furthermore, in castrated male rats, it was possible to obtain with androsteron a complete cytologic regeneration of the atrophied seminal vesicles (positive test according to Lœwe-Voss). Finally the "wedding dress" picture of the male small fish called *Rhodeus amarus*, which is obtainable with testicular extracts, could also be produced with androsteron. All the experiments which have been carried out in the past with the various extracts exhibiting the action of the male sex hormone, and especially with testicular extracts, will be repeated with synthetic androsteron, which will subsequently also be tested clinically. These experiments will show whether androsteron, or any of its derivatives possessing stronger physiological properties, can completely play the rôle of the male sex hormone.

Locust Research Work in India.

By Rao Sahib Y. Ramachandra Rao, M.A., F.R.E.S.,
Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi.

I. INTRODUCTORY.

DURING the last decade, locusts have, in many parts of the world, been so much in the limelight that they hardly stand in need of introduction. During the years 1929 and 1930 especially, there were not many days on which mention was not made of them in the Indian Dailies, either in regard to their flights or the damage done by them to crops. Nor are locusts to be counted as one of the recent upheavals of the modern age. Their history apparently dates back to hoary antiquity. They are mentioned in the Bible, and formed one of the plagues of ancient Egypt. In early Sanskrit literature, references are made to them as one of the recognised calamities of the people. The immensity of the swarms, whose countless myriads often form clouds hiding the sun from the face of the earth, the dramatic suddenness of their appearance, and the terrible severity of their onslaughts, have all combined to infuse a feeling of helplessness and awe in the mind of primitive man, with the result that incursions of locusts have from time immemorial been considered to be of the nature of an act of God. Indeed, the Indian cultivator, be he Moslem or Hindu, often expresses himself unwilling to lift his hand against these pests, ruinous though they may be to his food-crops, as he believes the visitation to be a manifestation of Divine Wrath, which he dare not resist.

II. INDIA'S LOCUSTS.

Few people are unfamiliar with grasshoppers, which may be found jumping about on the surface of lawns and fields. Locusts differ very little from them either in their general form, structure or habits, except for the fact that they often occur in large communities, which move about from place to place in gregarious swarms. There are several different species of locusts in the world, each of which has its own more or less restricted area of distribution. Not taking into account half a dozen species of Indian grasshoppers, which are known to increase in numbers periodically and cause immense damage to crops, there are only three species of true locusts in India, of which one, *Locusta migratoria*, though occurring widespread over the length and breadth of this country in its solitary phase, has, for some hitherto unaccountable reason, been very rarely recorded in its swarming condition. The other two, *viz.*, *Patanga succincta*, L.—the Bombay Locust,—and *Schistocerca gregaria*, Forsk.—the Desert Locust,—have in the past appeared in enormous swarms over large areas of India and caused a great deal of destruction to agricultural crops. Of the two, the Bombay Locust affects mostly the peninsular region of India. From the information available, mainly Lefroy's account in his *Memoir* on the Bombay Locust, this locust would appear normally to be a denizen of the forest areas of the Western Ghat ranges of the Bombay Presidency, whose flights may spread in years of heavy multiplication far and wide, as far as Guzerat to the north, as far as Central India and Hyderabad, and even Bihar and Orissa in some years, to the east, as far as Madras Deccan to the south, and upto Ratnagiri and Goa to the west. On the other hand, the Desert Locust is, *par excellence*, the Locust of North-West India. During years of outbreak, it infests chiefly Baluchistan, Sind, Punjab, the North-West Frontier, Rajputana, United Provinces and parts of Central India, but in years of extraordinary activity its flights may reach as far as east Assam and as far south as Madras Deccan. The Desert Locust is by far the more important of the two, for, the range of its spread is much wider, the periods of its outbreak are more frequent and prolonged, and the extent and degree of damage to crops is on the whole much greater. The scheme of Locust Research carried on under the auspices of the Imperial Council of Agricultural Research is concerned at present only with the Desert Locust.

III. THE ORIGIN AND SCOPE OF THE PRESENT SCHEME.

Although locust outbreaks have been fairly frequent in the past, and have often been serious enough to engage the attention of a huge staff and lead to the expenditure of large sums of money in connection with control work in a great many districts of North-West India, it is surprising how little had been recorded about the central facts of its life. There were but vague and

indefinite notions as to wherefrom the swarms originated or how they responded to changes in the environment. Except for the excellent account given by E. C. Cotes in his Report on "the Locust of North-West India", 1890, no comprehensive survey of the movements of locusts in India had been made during the various locust cycles of the past. The reasons for this are not far to seek. The incursions of locusts are periodic and even during outbreaks, their appearance is definitely seasonal in most places. While they are aggressively evident during times of invasions, and while the Government as well as the public are feverishly active with the carrying out of control measures against them, sooner or later they disappear from the areas of infestation, and before long they become a mere memory. People feel relieved at their non-appearance, and take no further interest in them till they are back once again menacing agriculture.

The provincial entomologist, who is naturally occupied with and interested in the pests of his own province, attends to a study of locusts and to their control while they are active within the limits of his province, but cannot of course be expected to continue his researches when they have retreated beyond the limits of his jurisdiction. On the other hand, in the desert regions of Baluchistan and Rajputana, where the locust appears to linger on during the periods of its non-activity, no entomological staff is existent to study the question. This would appear to be the main reason why so little is known of the life-economy of the Desert Locust and why the problem has been so little investigated. In the case of a pest of this description whose distribution is not confined to a single province or country and whose powers of spread by direct flight are so enormous, a proper study of its life-habits or migration can obviously be undertaken by an organisation working under the ægis of a Central Government.

After a long period of quiescence lasting over six years, the Desert Locust appeared all of a sudden in Sind and Rajputana in August–September, 1926 and bred in enormous numbers, thereby starting the last great cycle of 1926–1931. The peak of the attack was reached in the years 1929–30, when almost all the provinces of North-West India were infested and the resulting swarms reached eastwards as far as Assam and southwards as far as Hyderabad (Deccan). It was in the thick of the fight against this formidable outbreak of the pest in the rich agricultural areas of Punjab, United Provinces and Sind, that the Governments of the various provinces of Northern India realised what serious proportions the locust menace could assume and how imperfect the existent knowledge of the locust problem in India was. As a result the question was included in the agenda of the Board of Agriculture in India, which met at Pusa in December, 1929. After due discussion, resolutions were passed at this meeting recommending (1) the formation of a Locust Bureau under the auspices of the Imperial Council of Agricultural Research for the prompt collection, collation and distribution of locust intelligence within Indian limits, (2) the institution of a Locust Research Scheme in India for conducting research in regard to control methods, for locating the permanent breeding grounds and the migration routes of the locust in India, and for working out its bionomics thoroughly, and (3) the organisation of control methods on efficient and co-ordinated lines in all the affected states and provinces, including the central storage of anti-locust material by the Central Government.

Action was taken by the Government on all these recommendations in due course. The Central Locust Bureau of the Imperial Council of Agricultural Research began to function early in February, 1930 and has been of great service in giving prompt warnings to areas subject to infestation, in regard to the activities of locusts. An Entomologist—Rai Sahib G. R. Dutt, B.A.—was also attached to the Central Bureau from May 1930 to March 1932. Arrangements were also made for the storage of some anti-locust material at Delhi.

Last but not least, a Locust Research Scheme financed by the Imperial Council of Agricultural Research began to function from December, 1930 under the charge of M. Afzal Husain, Esq., M.A. (Cantab.), M.Sc., I.A.S., Entomologist to the Government of Punjab, as Locust Research Entomologist to the Imperial Council of Agricultural Research with head-quarters at Lyallpore. Through the kind permission of the Punjab Department of Agriculture, the Locust Research Scheme had the benefit of all the facilities of the up-to-date laboratories of the Entomological Section at Lyallpore, and various problems connected with the life-history and bionomics of the locust were

worked out during the years 1931, 1932 and 1933, by specially appointed staff under the direct guidance of Mr. Afzal Husain. Much difficulty was, however, felt during 1932 and 1933 in obtaining live material for experimentation owing to the disappearance of locust swarms by the end of 1931.

In regard to the location of the locust breeding grounds, a special touring staff was recruited in January 1931 for carrying out locust surveys of the desert areas in Baluchistan, Sind and Rajputana, and placed under the writer, as Deputy Locust Research Entomologist to the Council, with headquarters at Quetta. As specimens of the solitary phase of the locust were discovered by the staff during the tours conducted in 1931 in the coastal areas of Mekran, a special Field Research Station was established at Pasni in the midst of typical locust breeding grounds in January 1932 and placed under the charge of Dr. K. R. Karandikar as Assistant Locust Research Entomologist for studying the ecology of the solitary phase locust in its natural habitat.

Since April, 1933 Mr. Afzal Husain's services were required by the Punjab Agricultural Department for the Principalship of the Punjab Agricultural College. He could not, therefore, continue to be in charge of the Locust Scheme, but undertook to continue his work on bionomics at Lyallpore, with the help of a research grant from the Imperial Council of Agricultural Research and the responsibilities of the charge of the rest of the Scheme devolved on the writer from that date.

IV. PROGRESS MADE IN THE LOCUST INVESTIGATION WORK.

Locust research has been in progress for over four years at the moment of writing, and it may be stated without exaggeration that quite a large amount of work has been accomplished. It may also be mentioned that the work done every year has been scrutinised by the Locust Advisory Committee of the Imperial Council and has had, therefore, the advantage of their approval and advice in most particulars. The progress made may be dealt with under the following heads :—

1. *Survey Work.*—In 1931 survey work was mostly confined to Baluchistan where most of the districts subject to locust infestation were examined, especially Mekran, Kharan, Lasbela and Chagai. A part of the Bahawalpore desert area was also examined. In 1932, survey staff was reorganised, and work was pushed on by means of a motor-lorry purchased by the Imperial Council for touring purposes, and various centres in the Indus Valley of Sind, parts of Baluchistan, and the Dera Ghazikhan District, and parts of Bahawalpore, Bikaner, Jodhpur, Cutch and Western India States were visited. Wherever roads were non-existent, as in the interior of the Indian Desert, tours were carried out on camel-back. In this manner, quite a number of places were located in which locusts of a non-gregarious character were noticeable. During 1933, the plan of survey work was changed. The work was confined to the areas where locusts of a non-migratory type had been located, and the places were visited periodically throughout the year in order to note the effect of the seasons on the activities of the solitary locusts. In 1934, the same plan was pursued, but with the addition of two Desert Observation posts where intensive observations on locusts were to be carried out in addition to the recording of certain simple bioclimatic data.

Results of Survey Work.—While locust swarms easily attract regular attention and their movements may be expected to be reported by existing official organisations, the existence of locusts in their non-gregarious form is apt to be missed altogether unless specially trained staff is employed to look for them in their natural habitat. Owing to the enormous extent and the comparative inaccessibility of the area to be examined, and the sparsity of the locust population, it would be rather futile to expect a high degree of thoroughness from the small staff employed. The results actually obtained have, however, been sufficient to indicate that, in certain cases, specimens of locusts of what looked like the solitary type were either the remnants of the swarms of 1931 or their descendants. It was also noticed that at present locusts are either entirely absent or are very sparse in many of the places where they were found abundantly in 1932. The observations made have also shown that as in the case of the migratory type, the non-gregarious type of locust is dependent on rainfall for oviposition and breeding, and there appears to be some evidence to show that, like the migratory phase, the non-gregarious type is capable of making migrations over short distances though only as individuals. On the whole, it would rather look as if locusts were gradually disappearing from the areas

of the Indian Desert, and the present situation rather indicates that the 'rek' areas of the Mekran Coast are possibly more important from the locust-breeding point of view.

In addition to making observations on locusts the staff engaged on survey work have also as far as possible attended to the collection of the flora and the fauna of the tracts examined.

2. *Bionomics.*—The various known facts of the life-history and the habits of the locust are ultimately referable to the fundamental peculiarities of its structure and to the nature of its response to the impact of its environment. An exact knowledge of the nature and extent of the responses exhibited by the locust can only be obtained by an experimental study conducted under clearly defined conditions; and the results of studies would be valuable, not only for offering an explanation in regard to the activities of locusts under natural conditions, but also for devising efficient control measures. Valuable work on these lines has been done at Lyallpore in regard to various points in the life-history of the locust, *viz.*, pairing, oviposition, post-embryonic development, effect of crowding and other conditions on the colouration, etc., of hoppers, number of broods in the year, the effect of various tropisms, etc. The results of these studies are now under publication by Mr. Afzal Husain.

3. *Ecological Work.*—Most of the work on the life-history and habits of the locust published in the past is referable to the gregarious phase of its existence, and very little is on record in regard to its solitary phase. Since the areas around Pasni are apparently some of the true breeding grounds of the Desert Locust, the data collected during the last three years, in regard to the behaviour of the solitary locust in response to fluctuations of environmental conditions incident to seasonal changes, should doubtless be of great value. The central problem of these ecological studies in the elucidation of the conditions under the influence of which the change of phase—*viz.*, from solitary to the gregarious—would occur in nature. From the Locust Research point of view, the importance of a breeding ground would depend on how far conditions favouring the building up of the initial swarms of an outbreak are present, in which case alone it would function as an outbreak centre.

From the experience gained so far, it is evident that seasonal rainfall is by far the most important factor in the life-economy of the solitary phase locust. Breeding can take place only if there is rainfall, and a building up of the population would become possible only if an acceleration of breeding and a rapid succession of generations are brought about by the persistence of the requisite favourable conditions of weather.

4. *Study of Past Outbreaks.*—The memory of the serious locust infestation which lasted for nearly six years from 1926 to 1931 is possibly still fresh in the minds of most people in North-West India. This cycle was preceded by a period of about six years, roughly from 1920 to 1925, in which there was no general infestation, and we are apparently now in a similar non-locust period which began from 1932 and has already lasted over three years at the present moment. From the data at present available it is difficult to say when this period would end and the next locust cycle would commence. In this connection, a study of the past invasions is of great importance and all attempts have been made to secure reliable data on the subject. It has, however, to be stated that past records on locusts have in most cases not been preserved, and the information obtainable in such as are existent is very fragmentary in character. In certain exceptionable cases, however, as in that of the season and crop reports published in the Gazettes of Punjab, Sind and Bombay, fairly detailed and continuous information is available from the year 1869, and these have been extracted, collated and studied. In certain other instances also, *e.g.*, the records of the Jaisalmer and Kalat States, detailed information was obtainable in regard to some years. A study of the old records has shown that there have been locust cycles during the following years since 1869: 1869 to 1881, 1889 to 1907, 1912 to 1919 and 1926 to 1931, the intervals being periods of locust disappearance. During years of outbreaks, it would appear that swarms are, during the earlier months of the year, active mostly in areas of winter and spring rainfall, such as Baluchistan and parts of the Punjab, Afghanistan and Persia, and lay eggs and breed there. The adult locusts produced by these broods would appear to commence their flights during the months of April, May and June, the general direction being eastwards towards Sind, Punjab and Rajputana, where

they breed after the receipt of monsoon rains. The resultant fliers would appear to fly during the autumn months, partly further east towards Bengal and Assam or to the south, and partly back to the west towards Baluchistan and Persia. The east-bound flights appear ultimately to perish while the west-bound ones are able to breed during the spring months in Baluchistan. It would also appear that the infestation is prolonged if this circulatory system of locust flight is kept up, and that the break-down of the cycle is probably brought about by the failure of broods due to unfavourable conditions of weather in one or other of the breeding areas.

The data collected from the various files have been extracted and arranged and are being mapped out month by month for the various years, and attempts are being made to correlate the movements with available meteorological data.

V. PRESENT POSITION OF THE WORK.

Much ground has already been covered, but there is yet much work to be done.

In regard to bionomics, progress of work has been impeded mostly for want of material for experimentation, and experiments will be resumed when there is sufficiency of material. The question of sex-maturation of the locust is specially important and needs being tackled. Experiments in regard to control measures will also be undertaken when sufficient material is available.

As to survey work, it is necessary that work should be continued until a decisive answer is obtainable to the question as to which of the areas in which the locust has been found in the non-gregarious state are really important in the production of swarms. It is also necessary to determine the exact conditions under which the transformation into the gregarious phase would take place in nature. In case it is definitely proved that there are outbreak centres within Indian limits, it would be imperative to undertake a trial of control measures on the breeding grounds to determine the best methods of tackling the pest in an early stage and thus nip the evil in the bud. When the migration routes followed by swarms during periods of infestation in India have been properly studied and plotted out, it ought to be possible to formulate a system of timely locust warnings, to neighbouring provinces or countries on the basis of such studies.

Gaps in Our Knowledge of the Indian Protozoa. I.—Ciliophora.

By B. L. Bhatia, D.Sc.

DURING the last four years, while preparing a volume on Ciliophora for the Fauna of British India, I have become aware of various gaps in our knowledge of these Protozoa. Although many more genera and species are now known from this sub-continent than was the case in 1916 when I first directed my attention to this group, there is still a vast and promising field for future workers to cultivate. The Ciliophora are a sub-phylum of the Protozoa, and include forms which live in water, soil, or as parasites of other animals. It is well known that species of fresh-water and soil protozoa are cosmopolitan. The record of Ciliophora known from India, Burma, and Ceylon now includes 274 species belonging to 101 genera. The majority of these are from fresh-water or from the soil. Most of them are the same as found in Europe or America, and there is every likelihood of those described as new, being found in other parts of the world also. This is due to the fact that the conditions of life in pools and ponds are much the same all over the world, and the fresh-water forms can be easily carried from one place to another, especially in the encysted form, by wind and animals. Unlike the fresh-water protozoa, the geographical distribution of parasites usually follows that of their hosts. Some parasites are unable to live in any other host than the one in which they naturally occur and show a host-parasite specificity, though, not unoften, the hosts living in the same habitat may adopt each other's parasites.

The Ciliophora are divided into two classes, *viz.*, CILIATA and SUCTORIA. Following Metcalf, the Opalinid ciliates which do not show a differentiation of the nuclear material into a macronucleus and a micronucleus, have been separated into a subclass and designated as PROTOCILIATA, the rest of the Ciliata which show this nuclear differentiation being called the EUCILIATA.

The Protociliata include a single family *Opalinidæ* which were formerly lumped with other Astomatous ciliates. They are clearly

'an offshoot from the primitive Ciliata before the latter had acquired true binuclearity and the subsequent dimorphism of nuclei'. Metcalf has divided the family into sub-families, PROTOOPALINÆ and OPALININÆ according as the number of nuclei is two or many. The former are not represented in India, and both genera of the latter, *viz.*, *Cepedea* and *Opalina* are known by 8 species of each from various frogs and toads. An examination of Anuran hosts other than those examined already is sure to reveal the existence of many new species. There are many problems about the morphology and physiology of the opalinids which also require further study. The cytoplasmic inclusions, the neuromotor complex as revealed by silver nitrate impregnation and exposure to light, the structure of the nuclei, the nuclear changes during life-history, the causes of the relatively greater abundance of these parasites in the tadpoles than in the adult, are some of the problems well worth further investigation.

The EUCILIATA are divided into 4 orders, *viz.*, HOLOTRICHA, SPIROTRICHA, PERITRICHA and CHONOTRICHA. In the Holotricha the cilia are uniformly distributed over the body in longitudinal rows or limited to particular areas. They comprise the sub-orders GYMNOSTOMATA, TRICHOSTOMATA, HYMENOSTOMATA and ASTOMATA.

All the sub-orders of Holotricha are well represented in India. The Gymnostomata are represented by such well-known genera as *Holophrya*, *Urotricha*, *Prorodon*, *Lacrymaria*, *Enchelis*, *Didinium*, *Coleps*, *Spathidium*, *Bütschlia*, *Litonotus*, *Loxophyllum*, *Dileptus*, *Loxodes*, *Nassula*, *Chilodonella*, etc. *Bütschlia parva* has been recorded from the stomach contents of the ox, and *Chilodonella rhesus* from the intestine of the common Bengal monkey. No representatives have so far been found of the families ACTINOBOLIDÆ, METACYSTIDÆ, DYSTERIDÆ, PYNCNOTHRICHIDÆ and FŒTTINGERIDÆ.

The Trichostomata are classified into 9 families of fresh-water genera, and 4 families of parasitic genera. The fresh-water Trichostomata are represented by species belonging to *Plagiopyla*, *Colpoda*, *Paramecium*, *Drepanomonas* and *Opisthostomum* and the parasitic ones by *Isotricha prostomum* and *Dasytricha ruminantium* from the stomach of ox, and *Charonella ventriculi* from the stomach of the mouse-deer, and three species of *Conchophthirius* which are commensals in the mantle chamber of *Lamellidens*. There are no records of the families SCIADOSTOMIDÆ, SPIROZONIDÆ, TRICHOSPIRIDÆ, CLATHROSTOMIDÆ, MARYNIDÆ and CYATHODINIIDÆ.

The Hymenostomata are represented by species belonging to *Frontonia*, *Sigmostomum*, *Trichoda*, *Glaucoma*, *Colpidium*, *Pseudoglaucoma*, *Stegochilum*, *Uronema*, *Ophryoglena*, *Cyclidium*, *Pleuronema*, *Balantiophorus*, *Urocentrum* and *Telotrichidium*. The families PHILASTERIDÆ, LEMBIDÆ, ANCISTRUMIDAE, and HYPOCOMIDÆ are not represented.

The Astomata are divided into 11 families of which the family ANOPLOPHRYIDÆ only is represented by 5 species of *Anoplophrya* and 1 species of *Maupasella*. The family HAPTOPHRYDÆ is doubtfully represented by two species of *Caudalina*, a genus inadequately characterised by Madhava Rao.

The Order SPIROTRICHA is characterised by the peristome possessing an adoral zone of cilia arranged in a left-handed spiral, leading to the cytostome. They comprise the sub-orders HETEROTRICHA, OLIGOTRICHA, ENTODINIOMORPHA, CTENOSTOMATA and HYPOTRICHA.

The Heterotricha are represented by species belonging to the well-known fresh-water genera like *Spirostomum*, *Stentor*, *Folliculina* and *Bursaria*, and equally well-known parasitic genera *Nyctotherus* and *Balantidium*. Nine species of *Nyctotherus* and sixteen species of *Balantidium* have been described from India and Ceylon. The families METOPIDÆ and LICNOPHORIDÆ are however not represented.

The Oligotricha are represented by species of *Halteria*, *Codonella* and *Tintinnopsis*, but the family STROBILIDIIDÆ is not represented.

The Entodiniomorpha including the parasitic genus *Entodinium* and other related genera has been exhaustively studied in a series of three monographs, by Kofoid and Mac Lennan on material collected some years previously at Coonoor and Colombo from the stomach of the ox. The original genera of the Ophryoscolecidæ, *Entodinium*, *Diplodinium* and *Ophryoscolex*, have been split up, and variously shuffled and recombined by various authors. As many as 10 genera and 43 species are recognised by Kofoid and Mac Lennan as occurring in the contents of the stomach of the ox, and species from the stomach of the mouse-deer. The family CYCLOPOSTHIIDÆ is not represented.

The sub-order Ctenostomata recently constituted by Kahl for including the families Epalcidæ, Mylestomidæ and Discomorphidæ, is altogether unrepresented in India, so far as our present knowledge goes. The Hypotricha have not been adequately studied, but still representatives have been recorded of all the principal families. Species of the genera *Peritromoides*, *Urostyla*, *Holosticha*, *Uroleptus*, *Pleurotricha*, *Gastrostyla*, *Gonostomum*, *Oxytricha*, *Balladinopsis*, *Euplotes*, *Aspidisca*, *Aspidiscopsis* have been recorded from different parts of the country.

In the order PERITRICHA are included cone-shaped or bell-shaped organisms, usually attached to various objects by a stalk arising from the dorsal surface. The stalk is frequently retractile like a spiral spring or is divided into a branching system. In the adult organism, the cilia are present only on the ventral surface which forms the vase of the cone. The adoral cilia are arranged in a right-handed spiral. The adoral row of cilia (in some forms two parallel rows), commences at a point on the ventral surface, and follows a course like that of a flat watch-spring till its outer end passes into a cone-shaped depression (or vestibulum), within which lies the cytostome leading to the cytopharynx. The cilia may be continued into the pharynx as such or may fuse to form an undulating membrane. Species of the genera *Scyphidia*, *Vorticella*, *Carchesium*, *Epistylis*, *Cothurina* and *Vaginicola* are known, but representatives of the family Urceolaridæ which includes such ectoparasites as *Urceolaria* and *Trichodina* have not been met with.

The order CHONOTRICHA has been constituted for a small group of forms formerly included in the Peritricha. The peristome is developed as a hyaline, spirally convolute, membranous funnel, one limb of which descends into an oral funnel. The order includes ectoparasites or commensals of crustacea and other aquatic creatures. No one has studied these forms in India so far.

The class SUCTORIA has been almost completely neglected in India. Only a very few species belonging to the genera *Tokophrya*, *Acineta*, *Podophrya* and *Sphærophrya* have been noted. No representative is known of 5 families out of 7 into which the group is divided. Some one should take up the study of this group, in order to make our records of the Protozoan fauna somewhat fuller.

We will now briefly survey some of the major groups of the animal kingdom and indicate from what particular hosts the parasitic ciliates have been studied, and from what others it should be possible to obtain suitable material. There are records of *Balantidium coli* from man, from Calcutta and Lahore but so far as we are aware not from any other part of the country. Cattle, sheep, goats, pigs and horses are our most useful domestic mammals. The rumen (paunch) and reticulum (honeycomb) of the ruminant stomach are œsophageal derivatives and as such contain no glands to secrete either acid or ferments. The contents consist of water and large quantities of saliva mixed with the partially triturated food of the animal, which consists of succulent or dried green plants and grain. The fluid serves as an ideal medium for the growth and multiplication of ciliates, flagellates, amœbæ and bacteria, and there is a Protozoan fauna more or less specific to the ruminants. Buisson (1923), Becker and Talbot (1927) and Dogiel (1927) have published useful work on the intestinal parasites of mammals. Till 1927, according to Dogiel, 65 species and varieties of Ophryoscolecidæ had been found in cattle, 32 in sheep and 19 in goats. As noted above, thanks to the labours of Kofoid and Mac Lennan (1930–33), no less than 43 species belonging to as many as 10 genera are now known from the stomach of the Indian ox (*Bos indicus*) from Coonoor and Colombo.

Jameson has described *Charonella ventriculi* from the cattle, and *Entodinium ovalis* from the mouse-deer from Ceylon. Cooper and Gulati (1926) described *Balantidium coli* var. *bovis* from the cattle. Apart from these interesting records, no one seems to have recorded or described any ciliate parasites from the sheep, goats, pigs or horses. E. Ghosh (1929) described what he regarded as new species of *Balantidium* and of *Chilodonella* from the monkey.

Ciliates are not generally found to occur in the alimentary canals of birds, reptiles or fishes, though one species each of *Balantidium* is known from a bird, a tortoise and a fish from other parts of the world. Frogs and toads are commonly infected with Opalinids, *Balantidium* and *Nyctotherus*. Eleven species of frogs and toads have been studied for their parasites and 17 species of Opalinids, 7 species of *Nyctotherus*, and 10 of *Balantidium* are known from them. Dobell (working in Ceylon in 1910), Ghosh and recently H. Ray in Calcutta, de Mello in Nova Goa, and

Bhatia and Gulati in the Punjab have contributed to our knowledge of these parasites.

Parasites and commensals from Mollusca include a species of *Nyctotherus*, a species of *Balantidium*, 3 species of *Conchopthirius*, and 3 species of *Anoplophrya*. Species of *Nyctotherus* and *Balantidium* are also known from the Cockroach and certain other Arthropods. Species of *Anoplophrya* and *Maupasella* are known from the fresh-water Oligochæte *Aelosoma* and from 2 species of the earthworm *Pheretima*. And lastly, Protozoa are known to parasitize other Protozoa, and a suctorian *Sphærophrya* sp. has been recorded from *Paramecium caudatum*.

Some of the ciliate parasites are very interesting from the morphological point of view. The holotrichan *Ichthyopthirius multifilus* which is parasitic in the skin of fish, the various ciliates which occur in the cæcum of the horse; *Trichodina* which slowly creeps over the external surface of *Hydra* and is also found on the skin of fish; *Spirochona* known to occur on the gills of fresh-water crustacea, and *Licnophora* which is an ectoparasite of various marine animals, should all be looked for by those who have an opportunity to do so, and will very likely be found.

In conclusion, we will say a few words about the regional distribution of the ciliates that have been recorded so far from various parts of India. Following the regional divisions of India as adopted by Stephenson in his volume on Oligochæta in the fauna of British India, the records are as follows :—

1. North-Western Territory (The drainage system of the Indus so far as comprised in the plains of India, including the Punjab, the N.W.F.P., N. Rajputana and Sind). 85 species belonging to 50 genera.
2. Western Himalayan Region (from Hazara to borders of Nepal, including Kashmir). 27 species belonging to 18 genera.
3. North-Eastern Frontier Region (Nepal and eastwards, including Assam). 8 species belonging to 7 genera.
4. Indo-Gangetic Plain (U. P., Bihar and Bengal). 74 species belonging to 39 genera.
5. Burma (including the Andamans and Nicobars). 4 species belonging to 3 genera.
6. Main Peninsular Area (including S. Rajputana and the Central India Agency). 17 species belonging to 12 genera.
7. Southern Region (S. of latitude 15°). 80 species belonging to 31 genera, which record includes 40 species from the stomach of the ox.
8. Western Region (Goa to Cutch, the Ghats to the Sea). 30 species belonging to 26 genera.
9. Ceylon—60 species belonging to 19 genera, which record includes 41 species from the stomach of the ox.

In the present state of our knowledge, no importance can be attached to the presence or absence of any species in the specified regions. Larger number of species as recorded from certain regions is simply due to the fact that these regions have been better worked out. Further work will doubtless show the all-India distribution of most of the species.

Mining and Geological Institute of India.

THE annual general meeting of the Mining and Geological Institute of India was held on 1st February 1935 at Calcutta. In his presidential address W. H. Bates (of Burn and Co.) has surveyed the growth and development of coal trade in Bihar and Orissa for the last 30 years. In his opinion the slump in coal market is not merely due to the world-wide trade depression, but to other local causes; and he considers that the future is not so gloomy as many would like us to believe, especially in view of the possible shortage of oil and other combustible products. The meeting was followed by the Annual Dinner with the Governor of Bengal as the chief guest. Interesting excursions were arranged to several places like Bokaro colliery, *Statesman* offices, etc. The most important work published in the *Transactions* of the year was Dr. Heron's paper on the mineral resources of Rajputana for which the author was rightly awarded the Government of India prize of Rs. 500 and a gold medal.

Insect Transmission of Spike Disease of Sandal (*Santalum album*, Linn.).

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THE infectious character of Spike Disease having been experimentally demonstrated in a number of ways,[1,2,3,4,5] the next logical step in the investigation was to elucidate the mode of its dissemination under natural conditions. Strong circumstantial evidence, observations of previous investigators and the experience of other related diseases, led to the suspicion that the disease is possibly carried by a specific vector, the nature of which was still obscure.

Platform experiments[6] carried out since 1931 showed that the activity of the vector is confined to certain seasons of the year and that it operates above ground. Further confirmation of this fact was obtained from the natural infections which occurred among the potted sandal plants kept distributed in a heavily spiked area. The caging experiments[6] carried out in the 6-acre regeneration plot at Jawlagiri and later at Nognoor, demonstrated that the vector was effectively screened off by muslin cloth or by wire gauze of 10 to 20 meshes to the inch. The fact that the percentage of disease incidence in a given area was roughly proportional to the intensity of the infliction of scars pointed to the existence of scar-producing agencies which were also possibly responsible for the transmission of the virus. Continued observations showed that 64 per cent. of the scar-bearing plants got spiked while an incidence of only 8 per cent. could be recorded among the control plants which had not received similar injuries.

At this stage of the investigation, the Imperial Forest Entomologist, Dehra Dun, was invited to take up the problem from the entomological point of view. The extensive survey of the insect fauna associated with spiked and healthy areas carried out by Chatterjee,[7] led to the incrimination of a number of groups and individuals as vectors of Spike Disease. A series of carefully designed transmission experiments with these insects was conducted and a "mass infection cage" also was constructed into which were released the insect fauna from heavily spiked areas. Healthy and spiked sandal plants in pots were kept in the cage, so that together with the insect fauna the cage represented a "miniature sandal forest".

The above studies have resulted in the accumulation of mass of useful information and, from an entomologist's point of view, present a unique and very valuable contribution to the forest Entomology of South India. But from the point of view of the problem of insect transmission of spike, the efforts did not lead to any positive results.

A careful study of the experimental technique employed in the above series of studies showed that (1) the insects for the mass infection cage were collected and brought from areas located 50 miles away from Bangalore where the mass infection cage was situated, a circumstance which might have contributed towards the negative results; (2) Dover and Appanna[8,9] state "with the insect fauna we were no more fortunate. In October 1932, we reported a population of twenty thousand and hoped that we should be able to increase it to more than a hundred thousand. But in spite of every effort, the population fluctuated in the vicinity of twenty thousand and it was confined to a very small number of species, though at least two hundred thousand insects representing practically every species taken on sandal in the forest of North Salem, were introduced between June 1932 and March 1933"; (3) The insect fauna released into the mass infection cage mainly consisted of collections made during the day and "en masse" experiments with night fauna were not carried out. Careful and extensive observations had revealed that the scars are inflicted in large numbers during the nights[6] and this fact emphasised the importance of experimenting with the nocturnal insect fauna.

The problem of insect transmission was again taken up in May 1934 and several modifications in the light of past experience were introduced in the experiments. One of the cages was put up right in the midst of a heavily spiked area at Jawlagiri so that the insects could be released into the cage

soon after collection in a "nascent condition". The Denkanikota cage was situated 4 miles away from the centre of insect collections. The insect fauna for the cages were collected from spiked areas—both from sandal and associated host plants—during the night from 9–30 P.M. to 5 A.M. Other experimental details relating to the cages are given in Table I.

TABLE I.

	Denkanikota	Jawlagiri
Dimensions of the cage ..	24′×12′×7′	25′×12′×7′
Mesh of wire gauze ..	20 to an inch.	20 to an inch.
Date of start	7-5-1934	19-8-1934
No. of sandal plants:		
Healthy	42	37
Spiked	24	35
Total number of types introduced into the cage from commencement to date of first spiking ..	190	252
Total number of insects ..	8,421	15,766
Virulence of disease in areas from which insects were collected ..	1	5

At the commencement of the experiments it was observed that the insects did not feed on the spiked plants while on the healthy they could be seen in large numbers. With a view to render the spiked plants more attractive to insect attack, a certain number of them were planted in steel drums (4′ × 1¾′) sunk in the ground. A number of healthy plants also were similarly planted up in the cage. These plants put on a new flush after a few weeks. A fresh batch of 23 healthy and 10 newly spiked plants bearing plenty of spiked foliage were introduced into the cage on 9—12—1934 so that the insects were given every chance to feed on the spiked plants. At the kind suggestion of Mr. M. V. Laurie, Provincial Sylviculturist, Madras (now Imperial Sylviculturist to the Government of India), the cage was partitioned on 9—12—1934 by a collapsible cloth screen. The spiked plants occupied one half of the cage while the healthy plants were placed in the other half. This arrangement enabled a control of the insect fauna in the cage, which could be driven to one or the other half of the cage and induced to feed on spiked or healthy plants as desired.

On 19—1—1935, one of the healthy plants in the cage at Jawlagiri looked highly suspicious after about 5 months and in the course of the next fortnight, the plant exhibited the characteristic symptoms of spike. Material from this plant was taken on 19—2—1935 to Denkanikota and utilised for grafting 6 healthy plants, two of which developed the disease on 28—5—1935, thus confirming that the spike symptoms produced through the agency of insects were transmissible by grafting in just the same manner as the natural spike tissue is capable of transmitting the disease. The infectious character of the disease produced by insects, was thus established, and was therefore identical with the natural spike occurring in forests not only with regard to the morphological symptoms but also with respect to its transmissibility of infection through grafting.

On 8—3—35 two more plants belonging to the same series at Jawlagiri manifested the disease. At this stage it was considered desirable to defoliate a certain number of the plants still continuing healthy, with a view to force out the masked symptoms if any. Mr. W. G. Dyson, District Forest Officer, North Salem, kindly suggested that only 50 per cent. of the plants should be subjected to this experiment while the rest should be allowed to remain in the cage. 15 from the August and 13 from the December batches of healthy plants were accordingly removed from the cage on 9—3—1935, defoliated and were kept under observation at Denkanikota. These plants were immediately replaced by an equal number of healthy plants. About the middle of April 1935, 5 among the defoliated and 8 among the plants which continued to remain in the cage, all belonging to the earlier August series got spiked, bringing up the total number of spiked plants to 16 out of the 37 healthy plants introduced into the cage at the very commencement of the investigation.

It should be made clear that so far there has been no disease incidence among the other two batches of healthy plants introduced into the cage in December 1934 and March 1935.* These plants are being kept under observation. It is remarkable, there has been no incidence among the healthy plants in the Denkanikota cage. It will be seen from Table I that the insect fauna both as regards types and individuals is very low in the case of the Denkanikota cage and the virulence of the Denkanikota area from which the insects were collected for the mass

* Since the above was sent to the press, one plant in the Denkanikota cage has got spiked.

infection cage, is only one-fifth of the virulence characterising the corresponding area at Jawlagiri. In the case of the Denkanikota cage, the insect collections had to be transported over a distance of four miles and were not therefore in as "*nascent*" a condition as those of Jawlagiri. These are possibly the causes for the negative results obtained so far at Denkanikota.

The remarkably high percentage of successful transmissions (43·2%) obtained at Jawlagiri in the mass infection cage, constitute a fundamental advance in the problem of spike disease investigation. The experiments establish that (1) the disease is insect-borne, (2) the insect-vectors occur during the nights, (3) that the vector responsible for disease transmission belongs to one of the 265 types introduced into the cage. On the basis of the frequency of occurrence, seasonal and regional distribution, numerical strength, their morphological characteristics and their reputation as vectors of allied diseases, a large number of groups and individuals have been eliminated, and the scope of our transmission studies with individual species has accordingly been restricted for the present, to three types of *pentatomidæ*, two of *jassidæ* and three of *fulgoridæ*. Transmission studies with these eight insects are now in progress.

Our best thanks are due to Mr. Dyson, D.F.O., North Salem, for his keen interest, constant encouragement and helpful criticisms during the entire course of these investigations, and to Mr. M. V. Laurie, Provincial Sylviculturist, for his many constructive suggestions. Our grateful thanks are also due to Sir C. V. Raman, KT., F.R.S., N.L., and Dr. V. Subrahmanyan for their kind and continued interest in the investigation.

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[3] Sreenivasaya and Naidu, *J. Indian Inst. Sci.*, **1928, 19, 244.**

[4] Narasimhan, *Phytopath.*, **1928, 18,** 815.

[5] Sreenivasaya, *J. Indian Inst. Sci.*, **1930, 13A,** 113.

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[7] Chatterjee, *Investigations on the Spike Disease of Sandal*, 1 and **2, 1931.**

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[9] Dover and Appanna, *Indian For. Rec.*, **1934, 20,** Pt. I.

The Science of Rubber.*

AMONG the natural products which have influenced the progress of modern civilization, rubber occupies a pre-eminent position. The discovery of vulcanisation in the middle of the last century marks the beginning of its technological development while the advent of the pneumatic tyre, the increasing employment of power vehicles and the air craft paved the way for the utilisation of rubber on a gigantic scale. The special and exclusive properties of this raw material, more particularly, its elasticity, high impermeability to gases and liquids, resistance to shock and sound, electrical insulation and a marked resistance to chemical attack, properties which characterise no other single individual material of construction, have been exploited to the fullest advantage by technologists and in this endeavour, they have been assisted by an army of investigators who have contributed to the fundamental aspects of the science of rubber which constitutes the main thesis of the book under review.

The author who was entrusted with the responsible task of solving the problem of war time rubber emergency in Germany had a very enviable opportunity of enriching his experience and this fortunate circumstance has secured for the volume a prestige and authority which none will grudge. The diffcult situation was successfully met by the author and his colleagues whose strenuous efforts in perfecting the process are still being continued. The personal touch of the author is refreshingly perceivable as one goes through the pages of the book.

In this short review it is not possible to do justice by referring to all the excellent aspects of this book, but it is sufficient if attention is called to a few of the most notable features of this volume and indicate the comprehensive and thorough manner in which the subject has been approached. Such a fine production has been made possible through the combined efforts of

* *The Science of Rubber*, edited by Prof. Dipl.-Ing. K. Memmler. Authorised English Translation—Edited by R. F. Dunbrook and V. N. Morris. (Reinhold Publishing Corporation, New York, 1934.) $ 15.00.

several experts who are entitled to speak with authority in their respective fields. The editors of the English translation have maintained the same ideal in view and have selected translators from among the Firestone Research staff, who are best qualified to translate the section of the book apportioned to them. The translators' notes and comments, which appear as footnotes, constitute a valuable feature of the English translation since they amplify, corroborate or supplement the information and thus furnish the reader with an enlarged and extended experience covering the newer developments since the German original was written.

The chapter on the Chemistry of rubber has an added interest since it includes a résumé of the work on the synthesis of rubber conducted in Germany under the stress of war, in the course of which a number of normal and abnormal types of artificial rubber were produced. It is not improbable, that in the near future, most of these will find an appropriate use in industry.

The chapter on vulcanisation, the fundamental process responsible for the phenomenal development of rubber industry, treats with all the latest theories of vulcanisation and accelerator action and indicates the future lines of development. To those interested in the physical properties of rubber, the chapter on the physics of rubber will offer the most interesting and stimulating reading. The colloid chemist in particular will welcome this chapter since it deals with the swelling and solution of rubber and provides him with an array of problems requiring elucidation. It may, however, be mentioned that in the course of reading the book one gets the impression that the pure research that has been conducted on the various aspects of rubber have an intimate bearing on the industrial application. For example, the results on the permeability of rubber to gases in the relation to the quality and treatment of rubber, which has been investigated so thoroughly have been exploited in the development of æronautics. The optical and electrical properties of rubber and its solution, which are of great technical importance, have also been treated.

For the first time, the physical methods of testing rubber have been brought together in a single chapter and this constitutes a very valuable contribution from the point of view of a technologist since most of these methods suggest possibilities of application in other fields of technology, more particularly in the fields of resins and plastics.

The chapter on the microscopy of technical vulcanizates, describes methods by which rubber can be investigated by reflected and transmitted lights as also by the dark field illumination, and these observations are illustrated by a series of faithfully and beautifully reproduced colour plates.

The fact that the Firestone Tyre and Rubber Company have permitted the members of their technical staff to engage themselves in this work of translation not only speaks of their progressive ideas but also of the high esteem in which Memmler's book is held by rubber technologists. This treatise on the science of rubber will be gratefully welcomed not only by those interested in the science and technology of rubber, but also by those interested in allied fields. It is hoped that the enterprising publishers who deserve to be congratulated in publishing this volume, will soon bring out an equally authoritative and comprehensive companion volume on the technology of rubber.

M. S.

Archæological Discoveries at Narunjadharao.

CONSIDERABLE importance is attached to the discoveries of Mr. U. T. Thakur, a young Sindhi Scholar at Narunjadharao, in Khairpur State. Experimental excavations have yielded interesting relics such as shells, bangles, images of Buddha, gold and copper, skeletons and pottery. It is anticipated that these discoveries will throw considerable light on the Mohenjadharao civilisation and the site will be revealed to the world as a centre of pre-Aryan culture. It is reported that Professor Ghory of Bombay has supported the claims of the discoverer. The State authorities have reserved the sites for further excavation and further work will be started in the coming winter.

Aquarium Fishes.*

IT is hardly realised that the ponds and ditches of India are full of small, brilliantly coloured fishes, some of which are greatly prized by aquarists in America and Europe. Millions of these fishes are trapped or netted every day for food purposes without the least idea that if a trade in these very fishes is properly organized, it can be a source of considerable income to the fishermen. An Englishman, whose wife and children were greatly interested at home in aquarium fishes, once enquired from the writer whether there were any aquarium fishes in India so that his family could spend a few happy hours with them every day during their stay in Calcutta. He was directed to collect fishes from any pond with a growth of aquatic plants and to his great surprise he obtained in one morning several specimens of *Brachydanio rerio*, *Esomus danricus*, *Barbus ticto*, *Barbus conchonius*, *Panchax panchax*, *Colisa lalia*, *Colisa fasciata*, *Nandus nandus*, *Badis badis*, *Ambassis lala*, etc., etc. The wealth of material is simply staggering and though in India fishes can be kept in aquaria with considerable ease, there are several points on which an aquarist needs instructions and proper guidance. Several books have been written on "Aquarium Fishes" to meet this need, but the recent book of William T. Innes of Philadelphia entitled "Exotic Aquarium Fishes" is the best work of general reference that has been published so far. Mr. Innes besides being the editor of a very popular journal "The Aquarium" is the author of "The Modern Aquarium" and "Goldfish Varieties and Tropical Aquarium Fishes". As an editor of a popular aquarium magazine, Mr. Innes is flooded with enquiries of all sorts and this has afforded him an opportunity to know what kind of an aquarium book general readers need and want.

The greatest need of an aquarist is to know how he can keep his aquarium and fish healthy and to meet this demand the author has devoted a great deal of space to "Primary Principles" dealing with oxygen, light, temperature and food. Attention is also directed to fishfoods, enemies and diseases of aquarium fishes, general management of aquarium and plants and planting. The classification of the aquarium fishes is in conformity with the rules of zoological nomenclature and in this connection the author had the benefit of the advice of Dr. George S. Myers, a great authority on the taxonomy of fishes. Each fish is properly illustrated and a vivid description of its habitat and habits is given. The author has given detailed information regarding the pronunciation of scientific names, the spawning of the egg-layers, the breeding of the live-bearers, the breeding of the Bubble-nest Builders, the hybrids and hybridising, the wholesale breeding of fishes and the sex changes in fishes. Useful hints are included about the collecting and transporting of aquarium fishes. An index of fishes and a cross index of general subject render the information contained in the book easily accessible. A special feature of the book is the inclusion of maps. There are seven small maps showing the world distribution of the 7 most important families of aquarium fishes. A world map is also given and under each species is included a key reference to the places on this map showing points from which the species has been taken. In short, the book is a compendium of much useful information concerning aquarium fishes and no pains have been spared to make it most up-to-date and authoritative. The author is to be congratulated on this production and the publishers, Messrs. Innes Publishing Company, have really brought out a work of art. The paper, the get-up, the printing, the binding, etc., are all that could be desired for the very moderate price of 5 dollars (postpaid).

S. L. H.

**Exotic Aquarium Fishes*, by William T. Innes. (Innes Publishing Company, Philadelphia.) Pp. 460, with 41 colour plates and 290 black-and-white illustrations. Price $ 5.

Letters to the Editor.

CONTENTS.

Note on Transport Phenomena and Quantum Mechanics.

IN a recent paper we have studied the transport phenomena by modifying Maxwell's method in the light of the new Statistical methods. The dynamics of Collision was studied by a method due to Perisco. In recent years Wave-mechanical collisional methods have been developed by several authors and Massey and Mohr have shown how collisional area obtained by the above methods can be used for studying transport phenomena.

In the present investigation we have incorporated the Wave-mechanical method for studying scattering of electrons by a positive nucleus and thus calculated the value of the constants A_1, A_2 represented by the expressions

$$A_1 = 2\pi \int I(\theta) \sin^2 \theta/2 . \sin\theta \, d\theta$$

$$A_2 = 2\pi \int I(\theta) \sin^3 \theta \, d\theta$$

where $I(\theta)$ is the intensity of scattering, θ is the angle of scattering.

Taking Wentzel's expression

$$I(\theta) = \left(\frac{Z\epsilon^2}{2mv^2}\right)^2 \int \frac{d\theta}{(\sin^2\theta/2 + b)^2}$$

where Z is the atomic number, ϵ = electronic charge, m the mass and v the velocity of the electron, $b = \frac{1}{4k^2R^2}$, $k = \frac{2\pi mv}{h}$, R = distance between the two particles.

For completely ionised stellar matter $r = \frac{1}{2}\left(\frac{Am_H}{\rho}\right)^{1/3}$ where A is the average mol. wt., m_H = wt. of the H atom, ρ the density of stellar matter.

We thus have

$$A_1 = 4\pi\left(\frac{Z\epsilon^2}{2mv^2}\right)^2\left[\log\frac{1+b}{b} - \frac{1}{1+b}\right]$$

$$A_2 = 16\pi\left(\frac{Z\epsilon^2}{2mv^2}\right)^2\left[(1+2b)\log\frac{1+b}{b} - 2\right]$$

A_1 and A_2 may be computed for different cases and their values introduced into our previous formula, would lead to the evaluation of viscosity k, conductivity h, self-diffusion D and diffusion between two different gases D_{12}.

In the following tables are given values for some well-known giant and dwarf stars.

The first three stars are assumed to contain completely ionised iron while the last two completely ionised Ca-atom. It has already been pointed out that Kothari's Model-Dwarf should be treated relativistically. Here however non-relativistic values have been

Stars	Density	Temp.	Viscosity k in e.s.u.	Conductivity in gm./cal.	Self-Diffusion D	Diffusion D_{12}
Model-Giant (Chapman) ..	0·1	7×10^6	$9\cdot986\times10^{-3}$	13·3	$1\cdot998\times10^1$	14·93
Capella	0·1234	$9\cdot08\times10^6$	·02	2·70	$6\cdot6\times10^3$	10·3
Model-Dwarf (Kothari) ..	$1\cdot36\times10^6$	$1\cdot37\times10^7$	$6\cdot904\times10^2$	$1\cdot685\times10^5$	6·048	
ϵ_2 Eridani	$9\cdot8\times10^4$	10^8	3·719	$3\cdot242\times10^4$	1·350	
Sirius B	5×10^4	10^9	1·216	$1\cdot658\times10^5$	·688	
" "	"	10^8	1·216	$1\cdot658\times10^4$	·688	
" "	"	$1\cdot37\times10^7$	1·216	$2\cdot271\times10^3$	·688	

calculated for comparison. It is noticed that viscosity and diffusion are effected by density alone increasing with increasing density while conductivity is a function of temperature as well.

For the relativistic case $I(\theta)$ involves a factor $(1-v^2/c^2)$ and hence is greatly diminished while for $v\sim c$, $I(\theta)\sim0$ and hence, k, $\mathfrak{L}$ and D have zero values.

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[1] Ganguli and Mitra, *Curr. Sci.; Ind. Jour. Phys.*, **1934**, **9**, 81.

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Note on Surface Tension and Its Variation with Temperature.

IN connection with a recent note[1] of Sibaiya "On the ratio of temperature co-efficients of surface tension and density" it may be pointed out that Cantor[2] who followed the same method as Sibaiya obtained the value of the ratio 2·33 instead of 2.

The nature of the cohesive forces has been studied in detail in recent years and the following relationship between Van der Waals force and the surface tension has been established.[3]

$$\text{Van der Waals Constant } a = 2\pi\int_0^R \psi(z)dz$$

$$\text{Surface Tension } \gamma = \pi\rho^2\int_0^R z\psi(z)dz$$

Lately London[4] has given a quantum-mechanical expression of Van der Waals force. According to him the interaction energy between two similar molecules is given by

$$\epsilon = -\tfrac{3}{4}\cdot\frac{\alpha^2 J}{R^6} = \frac{k}{R^6}$$

where J is the ionisation potential, α the polarisability and R the distance between the molecules. This corresponds to the potential $\psi(z)$ of Laplace. By introducing the above expression for $\psi(z)$ we have

$$\gamma = \frac{\pi k\rho^2}{4d^2} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

Expression (1) was derived by Gyemant[5] as well by considering the surface energy originating from electric dipole.

By differentiating (1) with respect to T

$$\frac{d\gamma}{dT} = \frac{2\pi k\rho}{4d^2}\frac{d\rho}{dT} - \frac{\pi k\rho^2}{4}\cdot\frac{2}{d^3}\cdot\frac{dd}{dT} + \frac{\pi\rho^2}{4d^2}\cdot\frac{dk}{dT}$$

or,

$$\frac{1}{\gamma}\cdot\frac{d\gamma}{dT} = \frac{2}{\rho}\frac{d\rho}{dT} - \frac{2}{d}\cdot\frac{dd}{dT} + \frac{1}{k}\cdot\frac{dk}{dT} \quad .. \quad (2)$$

If β be the co-efficient of cubical expansion = thrice the co-efficient of linear expansion,

$$\frac{1}{\gamma}\cdot\frac{d\gamma}{dT} = -2\cdot66\,\beta + \frac{1}{k}\frac{dk}{dT} \quad .. \quad .. \quad (3)$$

Now in order to study the effect of temperature on k we must remember that

$$k = -\tfrac{3}{4}\,h\nu_0\alpha^2, \text{ where } \alpha = \alpha_0 + \frac{\mu^2}{3kT},$$

$$\nu_0 = \frac{e}{\sqrt{m\alpha}} \text{ and } h\nu_0 = J.$$

If there is no permanent dipole moment ($\mu=0$) α and ν_0 and so k are independent of temperature. On the other hand if $\alpha_0 \ll \frac{\mu^2}{3kT}$, the expression for surface tension reduces to the formula similar to Gyemant's and

$$k = -\tfrac{3}{4}\cdot\frac{hc}{\sqrt{m}}\cdot\frac{\mu^3}{(3k)^{3/2}}\cdot\frac{1}{T^{3/2}}, \text{ and}$$

$$\frac{1}{k}\cdot\frac{dk}{dT} = -\frac{3}{2T}.$$

It should however be noted that London's

formula is to be modified for complex substances such as liquids and solids. That solids have surface tension has now been pretty well established. In the case of adsorption of gases the adsorbed molecules are held to the surface of the adsorbent by cohesive forces. Now it has been observed that the same adsorbent may adsorb varying amounts of adsorbent, when subjected to different treatment. Activation of charcoal is a familiar instance. It is supposed that the specific surface increases with activation. Now if the total surface energy be the same then the increase of surface would be associated with the decrease of surface energy per unit surface and this would lead to a corresponding decrease of adsorption per unit area. This is not actually the case. The total adsorption increases and if the adsorption per unit surface is the same, this would mean constancy of surface energy. Thus for solids it is preferable to study surface tension by considering the surface density of molecules distributed over surface, the surface layer being one or several molecules thick and this ρ in the expression (1) should be replaced by $1/\Omega$, Ω being the available surface.

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Colloidalisation and Cold-Working of Metals.

THE subject of the magnetic properties of non-ferromagnetic metals has attained much interest recently in view of the work of Pauli, Sommerfeld and others on the theory of the metallic state.[1] The simplest picture of the metal that will suit our purpose consists of a lattice of metallic ions, the remaining electrons in each atom being associated with two or more nuclei and considered as free or partly bound in accordance with their relative energy values. The susceptibility of the metal is to be considered as the sum of the susceptibilities of the ions and of the remaining or valency electrons of the individual atoms. The first part is a constant while the second is greatly influenced by the physical conditions. The large deviations in the values for metals obtained by different workers is to be attributed to the fact that their metals were not in the same state and hence the susceptibility of the valency electrons should have been greatly different.

The valency electrons may have large orbits as contemplated by Ehrenfest[2] for graphite and by Raman[3] for bismuth. Or they may be attached loosely to two close atoms, being considered as free or partly bound. On colloidalisation, the first type would give rise to decreased diamagnetism due to the fact that large orbits could not be possible at the surface. This conclusion has been experimentally established for graphite[4] and bismuth,[5] and in fact, in the case of graphite, Krishnan and Ganguli[6] have determined the direction of largest variation as the one parallel to the hexagonal axis.

In the case of good conductors, the state of affairs is different. The electrons on the surface of the atoms may be considered as free, the number of such electrons being of the same order as the number of atoms in the metal. Considered as free, the electrons possess the Pauli paramagnetism and if regarded as confined to a series of energy bands, they contribute a diamagnetic component.

Honda and Shimizu[7] have shown that cold-working in the case of copper and silver gives rise to increased diamagnetism. They have quantitatively accounted for this result as being due (1) to the decrease in paramagnetic component due to the diminution of free electrons caused by the expansion on cold-working (for which there is ample evidence from X-ray data[8]) and (2) to the increase in the diamagnetic component due to the increased number of bound electrons. They explain that the lattice constant is a little greater in the surface layer than in the interior, the normal value for the metal being reached at some hundred layers below the surface. Thus colloidalisation should be accompanied by increased diamagnetism quite similar to what is obtained in the case of cold-working.

Attention has been drawn to this similarity in the case of tin by Honda and Shimizu.[9]

I have recently verified this result in the case of copper. Colloidalisation by condensed electric discharge in an inert organic liquid in the absence of air, gives rise to an increase in the diamagnetic susceptibility. The question of impurities affecting the measurements does not arise here since all the ordinary compounds of copper are paramagnetic or less diamagnetic than the metal. Here then we have a new kind of increased diamagnetism on colloidalisation.

I take this opportunity of drawing attention to a recent letter in these pages by Verma and Gupta.[10] They have once again drawn attention to the old question of impurities modifying the results. I shall content myself here by just mentioning that they have not been fair to the literature on the subject. It is enough if mention is made of the fact that the fundamental experiment which settled the decrease of diamagnetism on colloidalisation in the case of bismuth was the observed recovery of the value of 1·32 (the value for the mass metal) on melting and cooling of a sample of the colloidal bismuth. In the rather profuse literature they have cited, they have omitted to quote the one paper[5] which outlined this conclusive experiment.

Full details will appear shortly elsewhere.

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[1] For a brief summary see Stoner, *Magnetism and Matter*, chapter XIV.

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[3] *Nature*, 1929, **123**, 945.

[4] *Ind. Jour. Phys.*, 1929, **4**, 139; 1930, **5**, 559; 1931, **6**, 241.

[5] *Ind. Jour. Phys.*, 1932, **7**, 35.

[6] *Curr. Sci.*, 1935, **3**, 472.

[7] *Nature*, 1933, **132**, 565.

[8] *Phil. Mag.*, 1934, **18**, 495.

[9] *Nature*, 1935, **135**, 108.

[10] *Curr. Sci.*, 1935, **3**, 611.

A Note on the Bond Energies from Raman Frequencies and Thermochemical Data.

GANESHAN[1] has measured the Raman frequencies corresponding to the Se=O and S=O bonds. From the data collected by him, it is clear that there is a general agreement between the bond energy values got from light scattering and those obtained from thermochemical data. A closer examination, however, reveals an appreciable discrepancy between the values of the heats of dissociation calculated from the Raman frequencies and those obtained from the thermochemical data relating to the *ions*. The present note deals with the significance of this disagreement.

It is to be noted that the heats of formation of the ions SeO_4^{--}, SeO_3^{--}, SO_4^{--} and SO_3^{--}, as given in the *International Critical Tables* (**5**, p. 178) are only relative in so far as they are calculated by arbitrarily assuming that the heat of formation of $H^+_{(aq)}$ from H_2 (in its standard state) is zero. In view of this fact, the values calculated by Ganeshan are to be interpreted as follows:

$$H_{2(\text{gas, 1 atmos.})} + Se_{(\text{solid})} + 2O_{2\ (\text{gas, 1 atmos.})} + aq \rightarrow 2H^+_{(aq)} + SeO_4^{--}_{(aq)} + 147 \text{ K. cals.} \quad (1)$$

$$4O \rightarrow 2O_{2(\text{gas, 1 atmos.})} + 232 \text{ K. cals.} \quad \cdots \quad (2)$$

Combining equations (1) and (2), one gets

$$H_{2(\text{gas, 1 atmos.})} + Se_{(\text{solid})} + 4\,O + aq \rightarrow 2H^+_{(aq)} + SeO_4^{--}_{(aq)} + 379 \text{ K. cals.} \quad (3)$$

Since the heat of formation of $H^+_{(aq)}$ is not known, that of $SeO_4^{--}_{(aq)}$ cannot be calculated. Furthermore, the heat of reaction as given in equation (3) does not give the absolute value of the heat of formation of SeO_4^{--}, so that one cannot expect it to agree with the value got from the Raman frequency of the Se=O bond.

The question then arises as to whether the Raman frequency gives an idea of the absolute heat of formation of SeO_4^{--} *ion* in solution. If this is true, one can put

$$Se_{(\text{solid})} + 4\ O + aq + 2\ominus \rightarrow SeO_4^{--}_{(aq)} + 344 \text{ K. cals.} \quad \cdots \quad (4)$$

Combining equations (3) and (4), one gets,

$$H_{2(\text{gas, 1 atmos.})} + aq \rightarrow 2\ H^+_{(aq)} + 2\ominus + 35 \text{ K. cals.} \quad \cdots \quad (5)$$

It is also possible to calculate the heat of reaction in equation (5) by knowing the Raman frequencies of SeO_3^{--}, SO_4^{--} and SO_3^{--}. Table I gives the values so obtained.

The large variance in the values for the heat of formation of $H^+_{(aq)}$ indicates that the Raman frequencies enable one to calculate only the heat of formation of *molecules* but not of *ions* in solution.

TABLE I.

Ion whose data are employed	Heat of formation of $H^+_{(aq)}$
SeO_4^{--}	35 K. cals.
SeO_3^{--}	39 ,,
SO_3^{--}	72 ,,
SO_4^{--}	42 ,,

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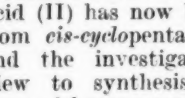
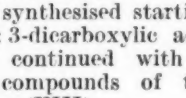
June 24, 1935.

[1] *Proc. Ind. Acad. Sci.*, 1934, **1**, 156

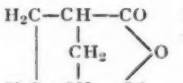
*Bi*cyclo (1 : 2 : 3)-*octane*-2 : 4-*dione*.

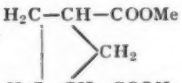
ALTHOUGH the constitution assigned to santene (I) by Semmler has been confirmed by direct synthesis,[1] the synthesis of the ketonic acids (II) isolated by Semmler and Bartelt[2] as an oxidation product of santene has not been achieved so far. The acid (II) has now been synthesised starting from *cis-cyclo*pentane-1 : 3-dicarboxylic acid and the investigation continued with a view to synthesising compounds of the type of homo*nor*camphor (VIII).

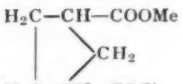

(I)

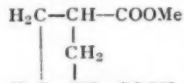

(II)

*Cis-cyclo*pentane—1 : 3-dicarboxylic anhydride (III)[3] furnishes the mono methyl ester (IV) in the usual way (b.p. 156°/4 mm.). The mono ester mono-acid chloride (V) prepared from (IV) by treatment with thionylchloride is a colourless mobile liquid (b.p. 109°/3 mm.) which gives by Blaise reaction with zinc methyl iodide the ketonic ester (VI) (b.p. 100°/2 mm. purified through semicarbazone, m.p. 139°). The ketonic acid (II) prepared from (VI) by hydrolysis boils when pure sharply at 155°/5 mm., and not within a range of 30°, *viz.*, 175–205°/10 mm. as given by Semmler and Bartelt.[2] They did not analyse this compound and it seems quite probable that their compound was not pure. The semicarbazone melts at 169° (Semmler and Bartelt 168°).


(III)

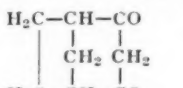

(IV)

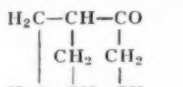

(V)


(VI)

The ketonic ester (VI) on treatment with sodium methoxide in alcoholic solution furnishes a product from which the ketonic acid (II) and a solid m.p. 123°·5 could be isolated by distillation, and subsequent treatment with petrol (obtained in poor yield). The solid gives a semicarbazone m.p. 224°, a brownish colouration with ferric chloride and evolves hydrobromic acid with bromine in chloroform solution and seems in all probability to be the bicyclic diketone (VII).

Experiments are in progress for obtaining the solid m.p. 123°·5 in workable quantities, with a view to confirming its structure as


(VII)


(VIII)

also to partially reduce it to the monoketone (VIII)—the next higher homologue of *nor*-camphor.

Full details will be published shortly elsewhere.

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S. K. RANGANATHAN.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
July 3, 1935.

[1] Diels and Alder, *Annalen*, 1931, **486**, 205.

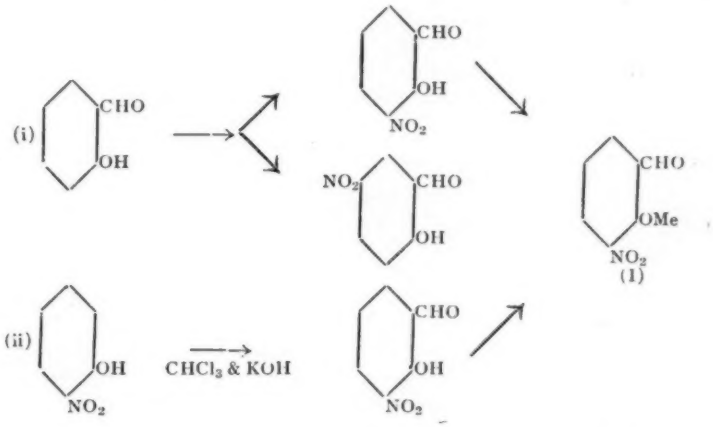
[2] Semmler and Bartelt, *Ber.*, 1907, **40**, 4596; *Ibid*, 1908, **41**, 128, 389, 867.

[3] Pospischill, *Ber.*, 1898, **31**, 1953; Perkin and Scarborough, *J.C.S.*, 1921, **119**, 1400.

A Preliminary Note on the Nitration of Methyl-Ether of Salicylaldehyde.

DURING the course of synthetical experiments in the group of alkaloids, we required Iso-Orthovanillin as a starting substance and it was thought that the latter might be obtained from 3-Nitromethyl-salicylaldehyde

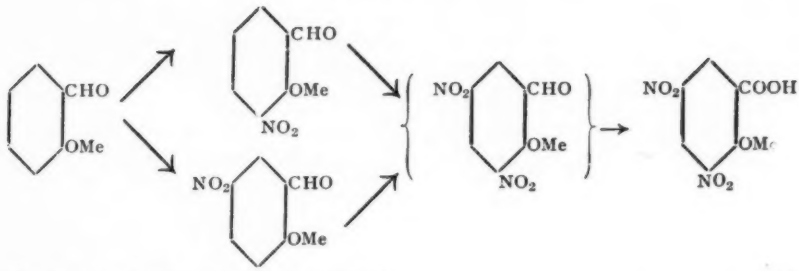
(I). 3-Nitromethyl-salicylaldehyde has so far been obtained only from 3-Nitrosalicylaldehyde which in its turn has been synthesised by two entirely different methods indicated below, one due to Miller,[1] and the other due to Sen and Ray[2] :—



Both the methods of preparation of 3-Nitrosalicylaldehyde are very tedious, and the method of Sen and Ray gives exceedingly poor yield. Further 3-Nitrosalicylaldehyde cannot be readily methylated by dimethylsulphate and alkali, and special methods (*viz.*, diazomethane or silver salt) have to be used for this purpose.[3] It was therefore thought desirable to explore methods of direct synthesis of 3-Nitromethylsalicylaldehyde.

Methyl ether of salicylaldehyde was first nitrated by Voswinckel,[4] and then by Schnell.[5] The latter author showed that if nitration were carried out with fuming nitric acid below 15°, then only 5-Nitrosalicylaldehyde-methylether is formed. These results were confirmed by Hodgson and Smith in 1930.[6] These results did not appear to the present author to be quite correct as it was thought that the 3-Nitrocompound should also have been formed just as in the case of the nitration of salicylaldehyde itself. A repetition of Schnell's experiment and careful working up of the nitration product showed that 3-Nitromethylsalicylaldehyde is actually formed in a yield of about 20%. The separation is best effected in the following manner. The crude solid nitration product is first carefully extracted with *cold* sodium carbonate solution, which extracts the dinitrosalicylic acid which is formed in small quantities at the same time. The dry residue is crystallised from benzene when 5-Nitromethylsalicylaldehyde m.p. 89° separates first. From the benzene mother-liquors petroleum ether (b.p. 30°–50°) precipitates a mixture m.p. 40°–50°. This is converted into the *p*-toluidide, and the *p*-toluidide subjected to a series of careful fractional crystallisations from alcohol. The *p*-toluidide of the 5-Nitro-compound which is only sparingly soluble in alcohol separates first in needles m.p. 165°, and from the mother-liquors the *p*-toluidide of the 3-Nitro-compound is then obtained in prismatic plates m.p. 92° (identical with the *p*-toluidide obtained from an authentic specimen of 3-Nitrosalicylaldehyde). The latter on hydrolysis gives 3-Nitromethylsalicylaldehyde m.p. 102°, identical in all respects with an authentic specimen of 3-Nitromethylsalicylaldehyde prepared by the older method—the mixed melting point being not lowered.

The results of these experiments may be briefly summarised thus :—



The detailed account of these experiments, and synthesis of Iso-ortho-Vanillin would be published elsewhere and are reserved for a future communication.

S. N. CHAKRAVARTI.

Annamalai University,
June 29, 1935.

[1] *Ber.*, 1887, **20**, 1928.

[2] *J. Indian Chem. Soc.*, 1932, **9**, 174.

[3] Compare Miller and Kinkelin, *Ber.*, 1889, **22**, 1709; Stoermer, *Ber.*, 1911, **44**, 655.

[4] *Ber.*, 1882, **15**, 2027.

[5] *Ber.*, 1884, **17**, 1382.

[6] *J. Chem. Soc. Industry, Transactions*, 1930, **49**, 409.

Ascorbic Acid Content of Some Plant Fluids.

IN an investigation on the occurrence of rich sources of ascorbic acid in Indian food materials, the water inside the coconut fruit and the juice sapped from coconut tree in a similar manner as in the case of date palms, as also juice drawn from the spadix of palmyra palm were examined. These juices and the coconut water are drunk as such and also as toddy (somewhat fermented juice). The following tabular statement gives a synopsis of a few observations :—

TABLE I.

Green Coconut (No Kernel yet formed).

	Volume of Water in one fruit	Natural pH	Volume of Standardised dye = mg. Ascorbic Acid for 10 c.c. Juice at pH·3
Sample 1 ..	340 c.c.	5·0	0·15 c.c. dye
Sample 2 ..	332 c.c.	4·8	0·12 c.c. dye
Sample 3 ..	320 c.c.	4·8	0·12 c.c. dye

TABLE II.

Green Coconut with Soft Kernel.

Sample 1 ..	450 c.c.	4·9	0·15 c.c. dye
Sample 2 ..	225 c.c.	5·0	0·29 c.c. dye

TABLE III.

Ripe and Dry Coconut with Hard Kernel.

Sample 1 ..	40 c.c.	5·1	0·00 c.c. dye
Sample 2 ..	150 c.c.	5·4	0·00 c.c. dye

	Volume of Water in one fruit	Natural pH	Volume of Standardised dye = mg. Ascorbic Acid for 10 c.c. Juice at pH·3

TABLE IV.

Juice from Date Palm Tree.

Sample 1 ..		4·6	1·08 c.c. dye
Sample 2 ..		4·5	1·10 c.c. dye

TABLE V.

Coconut Tree Juice.

Sample 1 ..		4·7	1·60 c.c. dye
Sample 2 ..		4·5	2·00 c.c. dye
Sample 3 ..		4·2	3·00 c.c. dye
Sample 4 ..		4·5	3·00 c.c. dye

TABLE VI.

Palmyra Palm Juice from Spadix.

Sample 1 ..		4·8	1·90 c.c. dye
Sample 2 ..		4·4	1·00 c.c. dye

Expressed juice from ripe pine apple fruits from local markets were also examined and some of the results are here given for comparison.

TABLE VII.

Pine Apple Juice.

Fruit Material	Juice Expressed	Natural pH	Titre for 10 c.c. Juice
Sample 1 100 g.	70 c.c.	4·0	0·20 c.c.
Sample 2 100 g.	70 c.c.	4·2	1·30 c.c.
Sample 3 100 g.	65 c.c.	4·2	1·00 c.c.

In the cases of the pine apple juice it was found that only a fraction of the total ascorbic acid is pressed out. Extraction by trichloro-acetic acid gave very much higher values—4 or 5 times as much.

As indicated above in the tables 1 c.c. of the 2 : 6 dichlorophenol-indophenol dye was standardised equivalent to 1 mg. ascorbic acid.

In the above estimations it may be noted that the volume of the dye required did not vary even after suitable treatment of the juices by mercuric acetate, H_2S, etc.

It will be seen from the above that coconut water loses ascorbic acid as the fruit ripens

and gets dry. Of all the plant saps examined coconut tree juice has been found to be the richest source of ascorbic acid. The quantity of juice yielded by date palm and palmyra palm trees daily is also quite considerable, so that the ascorbic acid excreted is very high. It was noted that the ascorbic acid content did not suffer any change even after spontaneous fermentation for 24 hours.

Further details and the transference of ascorbic acid from the water into the kernel according to age of the fruit etc. will appear in the *Transactions of the Bose Research Institute.*

HIRENDRA NATH BANERJEE.
Bose Research Institute,
Calcutta,
June 25, 1935.

The Cultivation of *Artemisia.*

FOR some time past attention has been directed to the cultivation of *Artemisia brevifolia* from seeds obtained from the santonine yielding varieties of the Kurram Valley (N.W.F.P.) and the Kashmir, with a view to raising the santonine content of the wild species. It has been reported, elsewhere,* that the Kurram *Artemisia* grows well in Dehra Dun, as a garden plant, but the plants divide themselves in two subforms designated as the *x*-form and the *y*-form; the only distinction between the two being that one produced the flower heads early in June and the other did not show any flower heads till late in the year. It was consequently suggested that the one flowering late was the original form and the earlier flowering variety was the acclimatised form. Similar growth has been noted in the case of the Kashmir *Artemisias.* During the first year some of the plants started flowering early (May-June) and the others did not flower till November suggesting again the original and the acclimatised form. Both the Kashmir and the Kurram Valley *Artemisias* have now well established themselves and the later observations have revealed the fact that instead of the two forms stated above there is only one, but that it produces flower heads twice a year and consequently has two periods of maximum santonine content, namely, June and December. The hope that the santonine content would rise on cultivation has, however, not yet been realised. The above observations are rather interesting from the point of view of cultivation of the drug and are therefore reported. The table given below gives the santonine content of the samples collected from the minor forest products gardens of the Forest Research Institute.

Time of collection weeks		Santonine percentage	Remarks
4, August	1933	0·60	Young leaves only
4, October	1933	0·79	Buds only
1, December	1933	0·91	Leaves and buds
1, January	1934	0·78	" "
1, February	1934	0·12	" "
1, March	1934	0·66	Fresh leaves
1, April	1934	0·80	Luxuriant growth but no buds
1, May	1934	0·84	" "
1, June	1934	0·85	Buds making appearance
3, June	1934	0·98	Buds
1, July	1934	0·52	Early rains dropped the buds
1, August	1934	0·22	" "
4, August	1934	0·62	Fresh young leaves

S. KRISHNA.
B. S. VARMA.
Forest Research Institute,
Dehra Dun, U.P.,
June 12, 1935.

* Krishna and Varma, *Quarterly Journal of Pharmacy and Pharmacology,* 1933, **6**, 23.

Czapek's Synthetic Medium.

CZAPEK'S formula for synthetic medium has been in use for over thirty years for culturing fungi. It consists of nitrate, phosphate, sulphate and chloride in addition to the organic principle, which is sucrose. It has, from time to time, been modified to suit the requirements of individual workers. In 1910 Dox modified this formula to present in a nearly neutral solution unaffected by sterilisation the elements necessary for the fungous growth. The original formula contained acid potassium phosphate (KH_2PO_4), while in this modified one Dipotassium hydrogen phosphate (K_2HPO_4) was used to obtain a neutral solution. Previous to this Dox[2] had used the original formula in a modified form with different proportions of the constituent salts. Currie[3] in 1917 used acid potassium phosphate for *Aspergillus niger.*

During the preparation of Czapek's solution as modified by Dox it was frequently noticed that the addition of ferrous sulphate solution gave traces of milkiness, while the

latter formula, according to which acid potassium phosphate was used, gave a clear solution as reported by Thom.[1]

On being heated to a high temperature in the autoclave, the milky product settles down as a bulky precipitate. The precipitate consists of magnesium phosphate with traces of iron. Thom[1] and later, Thom and Currie[4] have also noticed traces of precipitated magnesium phosphate.

In this note an attempt is made to study the chemical reactions of the constituent inorganic salts and the effect of the high autoclave temperature on the reactions. One per cent. solutions of pure salts in distilled water were used.

Magnesium sulphate and di-potassium hydrogen phosphate react only at the boiling temperature, when magnesium precipitates as the phosphate. The presence of sodium nitrate alone or with potassium chloride has no effect on the reaction. But the presence of ferrous sulphate even in traces has its part in the reaction and iron is also precipitated along with magnesium even at the ordinary temperature as well as at the boiling or autoclave temperature.

Magnesium sulphate and sodium nitrate or potassium chloride in the absence of di-potassium phosphate do not give a precipitate either at the ordinary temperature or on boiling, even when potassium chloride is present. But when ferrous sulphate is present, slight milkiness is produced, which, on boiling, disappears. When subjected to the high temperature in the autoclave ferric oxide is precipitated.

Ferrous sulphate reacts with di-potassium phosphate at the ordinary temperature even in the absence of magnesium sulphate or potassium chloride and gives a precipitate of ferrous phosphate.

Sodium nitrate and ferrous sulphate do not give any precipitate but in presence of potassium chloride some milkiness is produced which disappears on boiling.

Even in aqueous solution ferrous sulphate changes at the temperature of the autoclave into ferric oxide.

B. S. NIGAM.

Plant Pathological Section,
Agricultural College,
Cawnpore.
June 13, 1935.

[1] Thom, C., *U. S. Dep. Agr., Bur. Anim. Indust. Bull.*, 1910, **118**, 22.

[2] Dox, A. W., *U. S. Dep. Agr., Bur. Anim. Indust. Bull.*, 1910, **120**, 37.

[3] Currie, J. N., *J. Biol. Chem.*, 1917, **31**, 29.

[4] Currie, J. N., and Thom, C., *J. Biol. Chem.*, 1915, **22**, 289.

Sterility of Crop-Plants and a Study of Their Root-System.

STERILITY in crop-plants is fairly well known indeed; it, therefore, does not need any special elucidation. Suffice it to mention that the phenomenon is attended with abundant vegetative growth and as a consequence the sterile plant or branch, in habit looks bushy (Figs. 3 and 4). Studies based on *Trifolium alexanderinum* L. (berseem),[1]

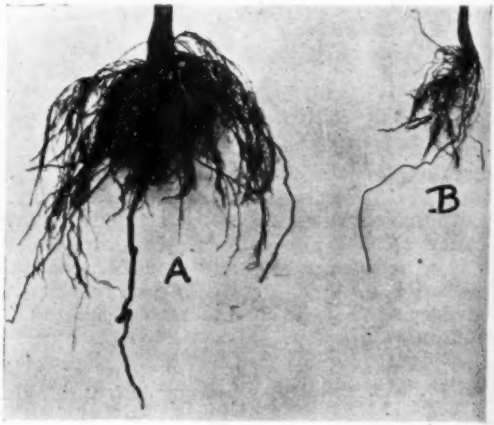


Fig. 1.

Sesamum indicum Linn. A—root-system of a healthy plant; B—root-system of a sterile plant. × 1/6.

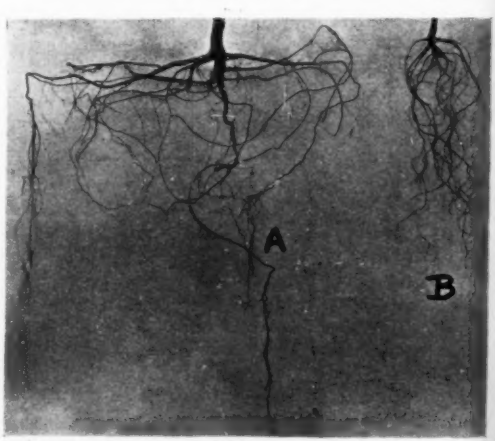


Fig. 2.

Cajanus indicus Spreng. A—root-system of a healthy plant; B—root-system of a sterile plant. × 1/20.

Crotalaria juncea L. (sunn-hemp), *Cajanus indicus* Spreng. (rahar), *Sesamum indicum* L. (til) and *Cicer arietinum* L. (gram), have

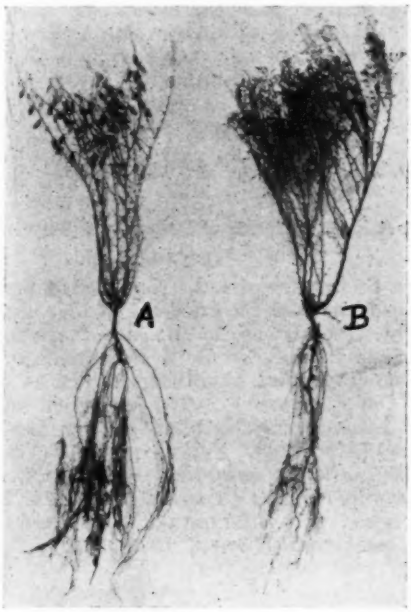


Fig. 3.

Cicer arietinum Linn. A—a normal plant with its strongly developed root-system; B—a sterile plant with its meagrely developed root-system. Note the bushy habit of the plant B. × 1/12.

shown beyond doubt that sterility observed in these is due largely to sepaloidy of petals and transformation of essential organs into very much branched shoots and leaves.[2] An extreme case, however, is found in *Cajanus indicus* Spreng. (rahar) where matters are not so clear as stated above.

A careful study of these sterile plants has evoked some interest. It has been noticed as a result of a number of root-washings that the display of root in sterile specimens is comparatively very poor, the tap- and secondary-roots being very weak and inadequate (Figs. 1-3). In addition, the number and size of root-nodules are also much smaller in the case of leguminous specimens. Whereas, in normal healthy plants, the development of the roots and nodules is fairly strong and profuse (Figs. 1-3).

This correlative study of the sterile plants and their root-system gave rise to the suspicion whether the phenomenon was not purely of a physiological nature rather than genetical as known in other crops, *e.g.*, rice.[3] At a time when this tentative conclusion was arrived at, all the crops had been harvested except *rahar* in which a number of sterile plants were available. Experiments could, therefore, be started only on one crop.

Sets of sterile *rahar* plants were treated as follows and controls were maintained as usual:

(*a*) Plants were irrigated at regular intervals with a very weak solution of pyro-phosphate of soda with a trace of potassium chloride.

(*b*) Plants were irrigated at regular intervals with very weak solution of metaphosphate of soda with a trace of potassium chloride.

(*c*) Two of the strong lateral roots in a plant were cut *in situ* and irrigated with well-water.

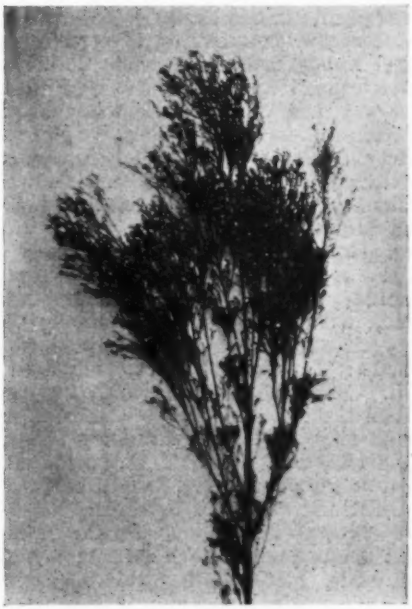


Fig. 4.

Crotalaria juncea Linn., a sterile shoot showing the characteristic bushy habit. × 1/6.

No difference was, however, noticed in the treated plants for about a couple of weeks after which curiously enough all of them started flowering. The control was without any flower.

These preliminary results have indicated the suspicion to be correct. It is proposed, therefore, to repeat this experiment on *rahar* and extend it to other crop-plants during the ensuing season.

I am much indebted to Rao Bahadur Viswanath (Imperial Chemist, Imperial Institute of Agricultural Research, Pusa) for certain useful suggestions.

T. C. N. SINGH.

Agricultural Research Institute,
Sabour (Bihar),
June 29, 1935.

[1] Singh, T. C. N., *Jour. Ind. Bot. Soc.*, 1930, **9**, (4), 250.

[2] Singh, T. C. N., *Plant Breeding Abstracts*, 1933, **4**, (3), 180.

[3] Anandan, M. and Krishnaswami, V., *Curr. Sci.*, 1934, **3**, (1), 21-23.

A New Variety of Black Gram or *Urid* (*Phaseolus mungo*, Linn.).

TWENTY-FIVE types of black gram (*Urid*) have been described by R. D. Bose.[1] In the course of the examination of certain pulses at the Millets Breeding Station, Coimbatore, a new type from Malabar not described by Bose was met with. It is classifiable under "Section 2.—Black seeded types, sub-variety Niger (Bose)". The following is a detailed description of this type.

Habit: Semi-erect, profuse branching, stem furrowed, covered with long brownish hairs pointed downwards, stems green with purple splashes here and there. *Leaves*: Trifoliate, small, ovate, acuminate, leaflets ovate, entire, light green, petioles—long, hairy, channelled, sometimes purple streaked. *Flowers*: In axile racemes, peduncle purplish. Flowers lemon-yellow, back of standard purple tinged at the top, calyx purple tinged. *Pods*: Erect to sub-erect, cylindrical, unripe pods dark purple with a green tinge at the tip. Pods covered by brownish hairs pointed upwards. Dry pods dark brown in colour. *Seeds*: Oblong, small about $\frac{1}{6}$ of an inch long, flattened at both ends, black, dull, (grey back-ground with heavy black marbling).

It will be noticed that this type is characterised by its purple pods. Purple colouring on the pods of pulses is common. Some red grams have this whole or in bands. Similarly in *Dolichos lablab* this colour is whole or localised in the periphery of pods. In green gram, purple along the suture line is noted. In cowpea purple podded varieties are common especially from Malabar. These manifestations of pod purple are mendelian in behaviour. It is therefore interesting to record this new purple podded variety in black gram of potential use in hybridisation.

G. N. RANGASWAMI AYYANGAR.
N. KRISHNASWAMI.

Millets Breeding Station,
Coimbatore,
April 13, 1935.

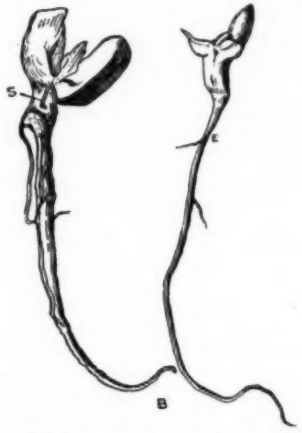
[1] *The Indian J. of Agr. Sci.*, 1932, **2**, 625.

A Rare Instance of Poly-Embryony in *Arachis hypogœa*, Willd.

THE occurrence of more than one embryo in a seed has been recorded by various authors from as early as 1719. Many species of various families in both Dicotyledons and Mono-cotyledons have been known to exhibit the phenomenon. It is prevalent among the common species like *Syzigium jambolanum* (*Myrtaceæ*), *Syzigium* spp. (Tiwary, 1926), *Citrus aurantium* (*Rutaceæ*) and *Mangifera indica* (*Anacardiaceæ*). In *Papilionaceæ*, poly-embryony has been noted in *glycine hispida* (Owen, 1928). But it has not been noticed, till now, in the groundnut, even though about a million groundnut plants have been examined during the last five years. Earnst (1918), Coulter, Barnes, Cowles (*Text-Book of Botany*) recorded a number of instances of poly-embryony.

A. Germinating groundnut seed showing two main roots.

While germinating a number of varieties of groundnut for root-tips, the authors observed that one seed of the variety "Bassi" was found to produce two radicals (Fig. A). Dissection of the seed revealed two seedlings. The bigger one was quite normal and the smaller had two thin, unequal cotyledons and a normal plumule. In the seed, the cotyledons of the smaller seedling were enclosed in between those of the bigger



B. Two seedlings separated. *E.* Extra seedling. × 2
S. Stalk by which the additional seedling is attached. × 2

one. At the top of the hypocotyl where the two cotyledons meet, there was a funicle-like structure connecting the hypocotyl of the extra seedling (Fig. B). Besides this, no other structure connecting the two seedlings was found.

The sources of the additional embryo or embryos are many and the correct origin could be determined best in the embryo-sac stage, which, in this instance, was not available.

J. S. PATEL.
G. V. NARAYANA.

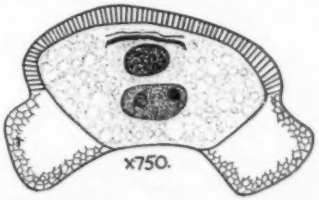
Oil Seeds Section,
Agricultural Research Institute,
Coimbatore,
June, 29, 1935.

A Note on the Shedding Condition of the Pollen Grains of *Pinus longifolia* Roxb.

POLLEN grains of all the species of *Pinus* so far investigated show two prothallial cells, one generative cell and one tube nucleus at the time of shedding (Schnarf,[1] p. 25). The only exception so far recorded is that of *Pinus longifolia* where Sethi[2] (see p. 133) reports that "Two prothallial cells are cut off while the pollen grain is still within the sporangium. These cells are more evanescent perhaps than in the other species of *Pinus* because they disorganise very soon and the pollen at the time of shedding stage shows no indications of them."

From this statement one would conclude that the development to form the tube and generative nuclei does not occur *in* the male cones. On further enquiry Dr. Sethi wrote that the mature pollen is only three-nucleate at the time of shedding and that the division to form the tube and generative nuclei occurred on the nucellus. As there are several cultivated trees of *P. longifolia* at Agra, it was suggested by Dr. P. Maheshwari that I should section some material to ascertain this point more definitely.

The first two divisions of the microspore nucleus result in the cutting off of two prothallial cells. As stated by Sethi these become flattened and disorganised very early. *The nucleus of the pollen grain divides*



A mature pollen grain of *P. longifolia*.

once again producing the tube and generative nuclei. The generative nucleus is smaller than the tube nucleus and takes a very dark stain with hæmatoxylin. It organises into a definite cell by gathering some cytoplasm around it. In spite of the ephemeral nature of the prothallial cells I could still find some favourable preparations in which all four nuclei were clearly distinguishable (see Fig.). I feel inclined to think that the material sectioned by Dr. Sethi was a little too young. The tube nucleus assumes an irregular shape at maturity.

I am indebted to Dr. P. Maheshwari for his kindly examining my preparations and confirming these observations.

B. M. JOHRI.

Botany Department,
Agra College,
May, 1935.

[1] *Embryologie der Gymnospermen*, 1933, Berlin.
[2] *Jour. Indian Bot. Soc.*, 1928, 7, 105.

On the Peculiar Apertures in the Vertebral Centra of *Hemidactylus flaviviridis* Rüppel.

IN the Patna Session (1933) of the Indian Science Congress, Mookerjee and Das read a paper[1] before the Section of Zoology on the presence in *Typhlops braminus* of an aperture in the middle of the ventral surface of the centrum of each vertebra towards the anterior half. Later, Mookerjee[2] published a paper in the *Proceedings of the Zoological Society* about them. He claims that these apertures have been recorded for the first time by him. Apparently, nobody after him has so far mentioned any other animal which shows these apertures, and hence I should like to mention the case of another Indian reptile, where similar apertures are present.

For the last two years, I have been engaged in an intensive study of the Bionomics, Anatomy and Distribution of the common Indian House-Gecko, *Hemidactylus flaviviridis* Rüppel, my purpose being to supply a detailed monograph for the Series "Indian Zoological Memoirs". During the course of this work, I have prepared alizarin-stained skeletons of every stage of this gecko from the just-hatched young one to the adult. In all cases, my preparations show the presence of two apertures on the ventral aspect of each vertebral centrum, these being placed one on each side of the median line. The apertures appear to serve for the passing in of blood-vessels and are quite unmistakable, when viewed under the lower magnifications (20-40) of a microscope. It is remarkable that the apertures in this case are *two*, and not one on each centrum, as described by Mookerjee for *Typhlops*. A detailed account of the main peculiarities of the endoskeleton of *Hemidactylus flaviviridis* is in course of preparation and will be published shortly elsewhere.

BENI CHARAN MAHENDRA.

St. John's College,
Agra,
June 3, 1935.

[1] H. K. Mookerjee and G. M. Das, "Notes on the peculiar apertures in the vertebral centra of *Typhlops braminus*."

[2] Mookerjee, H. K., "On the peculiar apertures in the vertebral centra of *Typhlops braminus*," *Proc. Zool. Soc.*, 1933, p. 283.

On the *Modus operandi* of Certain Ossicles in the Gastric Armature of Decapod Crustacea.

MOCQUARD[1] (1883), Pearson[2] (1908) and Patwardhan[3,4,5,6] (1934–35) have pointed out that the active movement of the gastric armature in *Decapoda* is brought about entirely by the anterior gastric muscles. Huxley[7] (1880) stated that the operation is effected by the anterior as well as the posterior gastric muscles. But the author [8,9,10] is of opinion that the active movement is the result of the contraction of the posterior gastric muscles, while the anterior gastric muscles and the cardio-pyloric constrictor muscles are mainly concerned in the restoration of the armature to its position of rest.

If the anterior gastric muscles were mainly responsible for the collision of the three teeth-bearing ossicles as suggested by Mocquard (1883), Pearson (1908) and Patwardhan (1934–35), one of the most essential factors, namely, the pressing down of the urocardiac tooth, to meet the colliding zygocardiac teeth could not be accomplished due to the reverted disposition of the propyloric ossicle (Figs. 1, 2 and 3, P.P.). For bringing the urocardiac tooth downwards, the posterior border of the propyloric ossicle which is bent over to the anterior side, has to be drawn backwards. This is possible only by contraction of the posterior gastric muscles. The anteriorly directed posterior border of the propyloric ossicle is wedged in between the exopyloric ossicles which give attachment to the posterior gastric muscles. The contraction of the said muscles results in pulling back the propyloric ossicle which, owing to the roof of the cardiac chamber, presses down the urocardiac tooth to meet the zygocardiac teeth.

The suggestions of Pearson (1908) and Patwardhan (1934–35) seem to have been entirely influenced by the statement of Mocquard (1883) who observed the action of the anterior gastric muscles in a living *Stenorynchus* having a remarkably transparent carapace. The author is of opinion that a re-investigation of *Stenorynchus* is desirable. In the fresh-water crayfish, *Astacus*, *Portunus*, American lobster, lobster, *Cancer*, *Nephrops* and *Paratelphusa*, described by Parker[11] (1876), Huxley (1880), Vitzou[12] (1882), Herrick[13] (1895), Williams[14] (1907), Pearson (1908), Yonge[15] (1924), Patwardhan (1934–35) respectively, the pro-

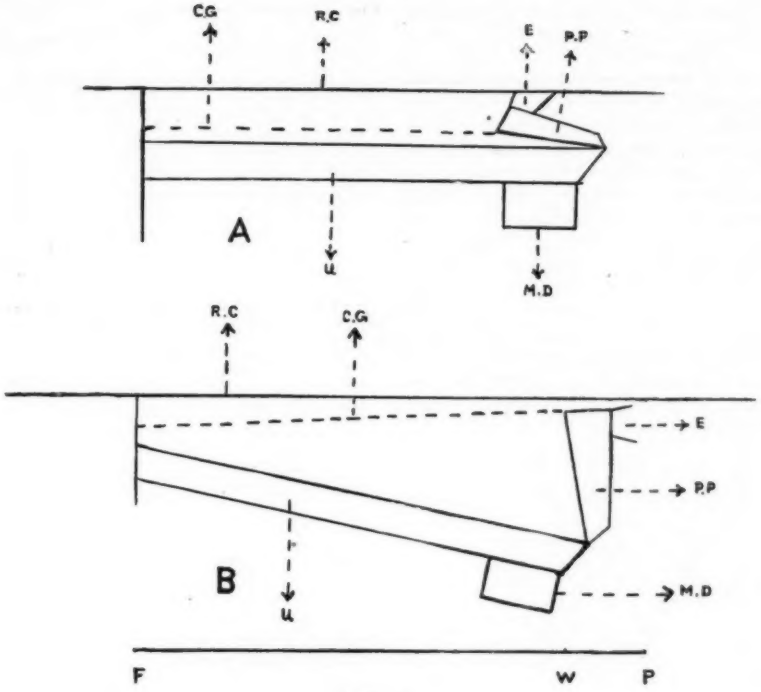


Fig. 1.

To show the action of the urocardiac ossicle.

A—Position at rest; B—Position at action.

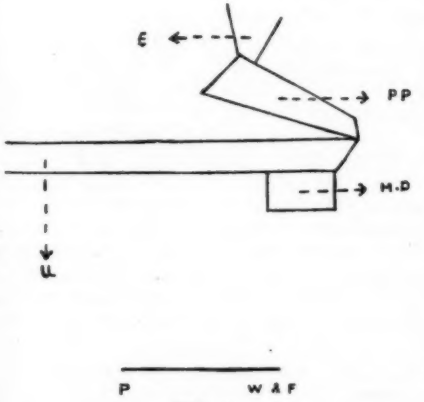


Fig. 2.

To show the action of the propyloric ossicle.

pyloric ossicle is definitely of a reverted disposition. Hence active movement of the gastric armature is possible only by the contraction of the posterior gastric muscles as indicated in Fig. 1, A and B.

Both the urocardiac and propyloric ossicles represent levers of the second order. In the case of the urocardiac ossicle (Fig. 1, A and B) the fulcrum is situated at its attachment with the mesocardiac ossicle while the power is applied at its hindermost extremity just behind the urocardiac tooth, by the anterior border of the propyloric ossicle. The power is the result of the contraction of the posterior gastric muscles and transferred to that point by means of the exopyloric and propyloric ossicles. The work is performed in the region of the urocardiac tooth. In the case of the propyloric ossicle (Fig. 2) the fulcrum is at the attachment of its anterior border with the hind end of the urocardiac ossicle and the power is applied by the exopyloric ossicles at its posterior border, while the work is done at a point near the fulcrum in pressing down the urocardiac tooth.

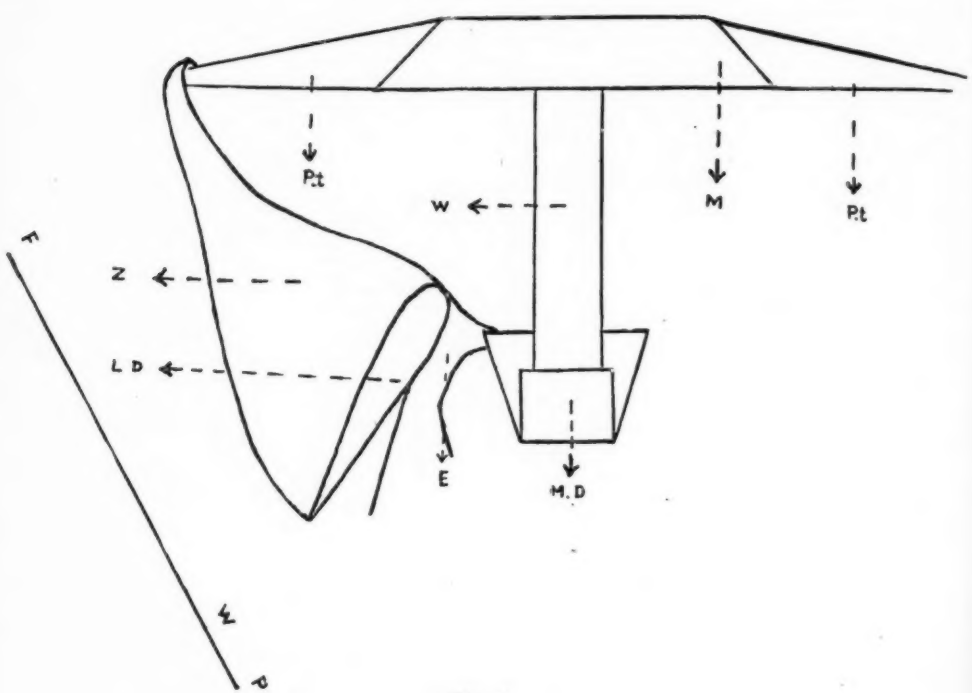


Fig. 3.

To show the action of the zygocardiac ossicle.

C. G.—Cardiopyloric Constrictor muscles; E.—Exopyloric ossicle; F.—Fulcrum; L. D.—Zygocardiac tooth; M.—Mesocardiac ossicle; M. D. Urocardiac tooth; P.—Power; Pt.—Pterocardiac ossicle; P. P.—Propyloric ossicle; R. C.—Roof of the Cardiac chamber; U—Urocardiac ossicle; W.—Weight; Z.—Zygocardiac ossicle.

Pearson (1908) on the supposition that the operation of the armature is effected by the anterior gastric muscles, locates both the point of application of power and fulcrum at the place of articulation of the zygocardiac ossicle with the outer end of the pterocardiac ossicle, while the work is turned out at the zygocardiac tooth and describes the action of the zygocardiac tooth as that of a lever of the second order considering the zygocardiac and exopyloric ossicles as a single bar. With the conditions described by him neither the zygocardiac ossicle with the exopyloric is a lever of the second order, nor is movement possible when power acts at the fulcrum. But if the power were to act at the exopyloric ossicle—as it should by the contraction of the posterior gastric muscles—then the action of the combined ossicles is that of a lever of the second order, with the fulcrum at the anterior end of the zygocardiac ossicle, the work being turned out in the region of the zygocardiac tooth and the power being applied at the exopyloric ossicle as illustrated in Fig. 3.

A. RAMAKRISHNA REDDY.
Annamalai University,
June 28, 1935.

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[1] Mocquard, A., "Researches anat. sur l'estomac des Crustaces podopthalmaires", *Ann. Sc. Nat.*, 1883, **6**, *t* 60.

[2] Pearson, J., "Cancer," *L.M.B.C. Memoirs*, 1908, **16**.

[3] Patwardhan, S. S., "On the structure and mechanism of the gastric mill in *Decapoda*. 1. The gastric mill of *Paratelphusa guerini* M. Edw.," *Proc. Ind. Acad. Sci.*, 1934, **1**, No. 5.

[4] Patwardhan, S. S., "On the structure and mechanism of the gastric mill in *Decapoda*. 2. *Brachyura*," *op. cit.*, **1**, No. 7.

[5] Patwardhan, S. S., "On the structure and mechanism of the gastric mill in *Decapoda*. 3. *Anomura*." *op. cit.* **1**, No. 8.

[6] Patwardhan, S. S., "On the structure and mechanism of the gastric mill in *Decapoda*. 4. *Macrura Reptantia*." *op. cit*, **1**, No. 8.

[7] Huxley, T. H., "The Crayfish," *International Scientific Series*, 1880.

[8] Reddy, A. R., "The gastric armature of some South Indian Decapod Crustacea," *Annamalai University Journal*, 1934, **4**, No. 1.

[9] Reddy, A. R., "A note on the variations in the gastric armature of some South Indian Decapod Crustaceans," *Proc. 22nd Ind. Sci. Cong.*, 1935.

[10] Reddy, A. R., "On the structure, mechanism and development of the gastric armature of *Stomatopoda* with a discussion as to its evolution in *Decapoda*." *Proc. Ind. Acad. Sci.*, 1935, **1**, No. 10.

[11] Parker, T. J., "On the stomach of Fresh-water Crayfish", *Jour. Anat. Physiol.*, 1876, 11.

[12] Vitzou, A. N., "Researches sur la, et la formation des tegumentes, chez les Crustaces Decapodes," *Arch. Zool. Exper.*, 1882, **10.**

[13] Herric, F. H., "The American Lobster," *Bull. U.S. Fish Comm.*, 1895, **15.**

[14] Williams, L. W., "The Stomach of the Lobster and the food of the Larval Lobsters," *37th Ann. Rep. Comm. of Inland Fish. Rhode Island*, 1907.

[15] Yonge, C. M. "The mechanism of feeding, digestion and absorption in *Nephrops Norwegicus*," *British Journal of Experimental Biology*, 1924, **1**, No. 2.

The Presence of Uncinate Processes on the Ribs of a Lacertilian.

UNCINATE processes are present in Birds, in some Temnospondyli among Stegocephalia, in the Rhynchocephalia, and in the Crocodilia.[1] Besides *Sphenodon* and crocodiles, they have not been recorded so far in any other living reptile. It is interesting, therefore, to mention their presence in a common Indian Lacertilian.

While making a detailed study of the endoskeleton of the housegecko, *Hemidactylus flaviviridis* Rüppel, I found that four anterior ribs bear such processes. These ribs are borne on the fourth, fifth, sixth and seventh cervical vertebræ and are partially hidden by the sternum and the pectoral arches. The processes themselves are extremely delicate and usually break off in the common methods of the preparation of skeleton. They, however, become quite distinct in an alizarin-stained skeleton.

The point is an important one, as it adds one more fact to the resemblances of some of the least specialised Lacertilia to *Sphenodon* and may be significant in the discussion of the latter animal's affinities. As is well known, some authorities[2] regard *Sphenodon* as the sole living representative of a primitive order of the Reptilia and consider it to be equal in rank to the other orders of this class. As opposed to this view, other zoologists[3] think that the differences between some Lacertilians and this animal are "not so great as to justify placing it in a separate order, but, on the contrary, it should be included in the Lacertilia."[4]

Incidentally, I might also take this opportunity of mentioning that Bhatia and Dayal[5] are wrong when they say, "The vertebral column in *Hemidactylus* is composed of 6 cervical, 5 thoracic, 15 lumber, 2 sacral, and large number of caudal vertebræ." Careful counting in alizarin-stained skeletons shows that the cervical vertebræ are eight and the lumbars thirteen, the total number of precaudal vertebræ being 28. These numbers also appear to tally remarkably with those of *Sphenodon*, as given by Howes and Swinnerton,[6] *viz.*, 8 cervical, 3–4 thoracic, 13–14 lumbar, and 2 sacral vertebræ, making a total of 26–28 precaudals. The difference in the numbers of the thoracic and the lumbar vertebræ of these two animals can be explained by the facts that the sternum in *Sphenodon* has no posterior continuations like that of *Hemidactylus* and that two of the thoracic ribs in the latter animal are connected to these continuations.

BENI CHARAN MAHENDRA.

St. John's College,
Agra,
June 3, 1935.

[1] Goodrich, E. S., *Studies on the Structure and Development of Vertebrates*, MacMillan, 1930, page 78.

[2] Günther, A., "Contributions to the Anatomy of *Hatteria* (*Rhynchocephalus*, Owen)", *Phil. Trans.*, 1867, **B, 167.**

[3] *E.g.*, Huxley.

[4] O'Donoghue, Chas. H., "The Blood Vascular System of the Tuatara, *Sphenodon punctatus*", *Phil. Trans.*, **B, 210,** 240. (He himself, however, does not subscribe to this view.)

[5] *Anat. Anz.*, **Bd. 76,** Nr. 23/24, page 432.

[6] *Trans. Zool. Soc.*, 1901, **16,** Part I.

The Hosts of *Eupelmus tachardiæ* How.

MAHDIHASSAN[1] under the heading "Specificity of parasiticism by *Eublemma amabilis*" raised several issues, but chiefly accused Glover for making "the glaring statement" that *Eupelmus tachardiæ* is "inimical to lac itself," and asserts that he has definitely proved it to be a parasite of *E. amabilis* caterpillars.

Replying to the above Glover and Negi[2] stated that during the last eight years many miles of lac encrustation and many thousands of *E. amabilis* larva had been examined at the Indian Lac Research Institute and that in no instance had *E. tachardiæ* been found

parasitic on *E. amabilis*, but that it had always been found endo-parasitic on the lac insect *Laccifer lacca* and ecto-parasitic on the larva of *Microbracon greeni* syn. *Microbracon* (*Bracon*) *tachardiæ*. In support of this contention a number of publications of the Lac Research Institute were cited and in particular the *Proceedings of the Indian Science Congress*, 1929 and 1933, which Mahdihassan appears to have overlooked.

Mahdihassan[3] makes the following statement "'some one has said what I say thrice is right'; acting according to the principle Negi and Glover have repeated what they have asserted twice before.[2,3] While they stress the point it is the third time their claim appears in print,—I beg equally to emphasise, thrice have they neglected to bring forth any illustrations or details with regard to the life-history of the insect or any objective information."

The *Abstract of the Proceedings of the Science Congress*, 1933, is fairly detailed and is quoted in part in the next paragraph: comparison of this abstract and Mahdihassan's statement above is interesting.

"The chalcid *E. tachardiæ* (syn. *B. annulicaudis*) is primarily an endo-parasite of the lac insect and an ecto-parasite of the full fed larva, pre-pupa and early pupa of *M. greeni* (syn. *E. tachardiæ*) a parasite of *E. amabilis* larva. The chalcid oviposits on the stages of *M. greeni* only if covered with a cocoon .....superparasitism and laying of more than one egg by the female on the same host occurs.....but in either case only one egg develops to the adult. The chalcid first deposits the egg on the host and paralyses it afterwards by several stings.....oviposition and longevity is described. The chalcid seems to have 14 theoretical generations in a year based on monthly life cycles."

Mahdihassan in spite of the *Abstracts of the Indian Science Congress* and other publications of the Institute, particularly the *Annual Report for the Year* 1930–1931, challenges us to produce figures and life-history data to substantiate our claim. For this reason in spite of the fact that the paper on *Eupelmus tachardiæ* has not yet been sent for final publication, we reproduce here a photograph of one of the figures shown at the Science Congress in 1933 and quote the following data.

During the last eight years during regular routine examination of lac samples a considerable number of cases have been observed of *E. tachardiæ* parasitic on both *M. greeni* and *Laccifer lacca*. In the Science Congress 1929 paper, Gupta, Negi and Misra stated that a specimen of *E. tachardiæ* had been reared from the larval stage parasitic on *Z. jujuba* lac, Mathurapur, Bengal, in March 1927, and that since then a number of males and females of this chalcid had been reared from larvæ and pupæ parasitic on lac insects at Namkum, but that it had never been found parasitic on *E. amabilis*. During the year 1930–31 *E. tachardiæ* was artificially bred in the Insectary on *M. greeni* larvæ which had spun cocoons in small glass capsules. The following life-history data were obtained, and quoted by Negi and Gupta at the Indian Science Congress, 1933.

Month in which life-history began	Egg Stage	Larval Stage	Pupal Stage	Total cycle
April 1930 ..	..	..	7 days	..
May 1930 ..	1 day	8 days	8 days	17 days
June 1930 ..	1 day	7 days	8 days	16 days
July 1930 ..	1 day	10 days	8 days	19 days
August 1930 ..	..	..	..	..
September 1930 .	..	..	7 days	..
October 1930 ..	..	..	16 days	..
November 1930 ..	..	..	34 days	..
December 1930 ..	5 days	40 days	19 days	64 days
January 1931 ..	3 days	31 days	14 days	48 days
February 1931 ..	6 days	35 days	12 days	53 days
March 1931 ..	..	..	11 days	..

In the above table the complete cycles are from *eggs laid in the Laboratory on* M. greeni *larvæ as host*: *where only the pupal stage is given it is taken from larvæ collected from the Field parasitic on* L. lacca.

We prefer to leave the reader to judge whether our claim that *E. tachardiæ* is parasitic on *L. lacca* and *M. greeni* based as it is on 8 years regular routine examination of lac samples, entailing the annual examination of over 100,000 lac cells and many thousands of *E. amabilis* larvæ, and further based on the actual breeding of *E. tachardiæ* on *M. greeni* in the Laboratory, has greater justification than Mahdihassan's claim that *E. tachardiæ* is parasitic on *E. amabilis* based on a single and rather doubtful instance.

The instance cited by Mahdihassan of *E. tachardiæ* parasitic on *E. amabilis* is as follows:—A larva was found attached to the body of an *E. amabilis* caterpillar, it pupated the following day. From our experience it seems possible that the *E.*

tachardiæ larva which was within a lac cell close to an *E. amabilis* larva was dislodged from its actual host *L. lacca* while dissecting the encrustation and came to lie

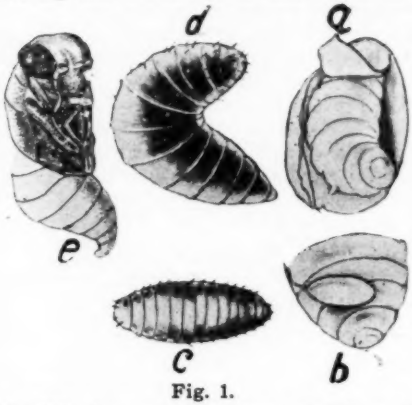

Fig. 1.

(*a*) A *Microbracon greeni* cocoon opened to show the paralysed *B. tachardiae* larva and the pencils and punctures formed between the larva and its cocoon as a result of the *E. tachardiae* (*B. annulicaudis*) pricks.
(*b*) The *E. tachardiae* egg lying over the posterior end of the *M. greeni* larva.
(*c*) Just hatched larva of *E. tachardiae*.
(*d*) Nearly full fed *E. tachardiae* larva (details not fully shown).
(*e*) The *E. tachardiae* prepupa casting the larval skin to turn into pupa.

on the *E. amabilis* larva before it was observed by Mahdihassan.

If Mahdihassan is still not fully convinced may we suggest that he try to breed *E. tachardiæ* in the Laboratory on both insects, *M. greeni* and *E. amabilis* and he will discover for himself that the former is a host of *E. tachardiæ*.

As regards Mahdihassan's other observations, we prefer at present to disregard them as they are of secondary importance and merely confuse the issue of the present discussion regarding the host of *E. tachardiæ*.

We should like to point out, however, that our specimens of *Eupelmus tachardiæ* were identified by Dr. Ch. Ferriere of the Imperial Bureau of Entomology, an expert on the *Chalcidoidea*.

P. M. GLOVER.
P. S. NEGI.
S. N. GUPTA.

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Namkum, Ranchi,
Bihar and Orissa.

[1] Mahdihassan, *Curr. Sci.*, **1934, 3, 260.**
[2] Glover, Negi, *Curr. Sci.* **1934, 3, 426.**
[3] Mahdihassan, *Curr. Sci.*, **1934, 3, 562.**

Alkaline Quartz-Dolerites, from Bijawar, and Their Chemical Relationships.

FOR some time the author has been working on the trappean[1] rocks which are found associated with the Bijawar system in the type area. Certain interesting results of chemical nature have been obtained and it has been thought desirable to publish them in the form of a short communication. The results of detailed investigation will be published later. A collection of rock specimens was made from intrusive masses occurring in the central part of the Bijawar outcrop. Under the microscope the rocks present a very decomposed appearance and are found to be medium-grained quartz-dolerites with a pale brown pyroxene and plagioclase felspar as their main constituents. Uralite, chlorite, biotite and epidote occur as secondary minerals. Micropegmatite occurs in the interstices, and needles of apatite are generally present. Iron oxides are very prominent and have crystallised later than the pyroxene and plagioclase. The pyroxene has been considerably altered to uralite and the plagioclase looks extremely clouded. Some plagioclase laths are so much crowded with decomposition products that they are indeterminable. Fresh felspar is rare, but when it is present it gives an extinction angle corresponding to labradorite.

TABLE I.

Chemical Comparison of the Bijawar Quartz-Dolerite with Deccan Basalt and Spilite.

	1	2	3	4	5	6
SiO_2 ..	50·30	51·00	49·50	50·27	49·68	51·22
Al_2O_3 ..	11·53	13·38	12·02	12·31	12·95	13·66
Fe_2O_3 ..	2·16	1·68	3·20	2·35	3·47	2·84
FeO ..	10·66	9·36	9·36	9·79	10·10	9·20
CaO ..	10·15	9·86	10·15	10·05	10·09	6·89
MgO ..	6·07	5·32	6·97	6·12	5·69	4·55
Na_2O ..	6·14	6·33	5·59	6·02	2·27	4·93
K_2O ..	·89	·64	1·12	·88	·52	·75
TiO_2 ..	1·23	1·13	1·17	1·18	2·00	3·32
P_2O_5 ..	·35	·42	·14	·30	·33	·29
MnO ..	·09	·08	·08	·08	·20	·25
$H_2O(+)$	·75	·90	·73	·79	1·71	1·88
$H_2O(-)$	·10	·16	·22	·16	·29	
CO_2 ..	N. D.	N. D.	N. D.	N. D.	..	·94
Incl ..	..	..	..	..	·04	..
TOTAL	100·42	100·26	100·25	100·30	99·94	..

(1) Quartz-dolerite, Chopra, Bijawar. (2) Quartz-dolerite, Rampur, Bijawar. (3) Quartz-dolerite, near Bajno, Bijawar. Analyst: M. P. Bajpai. (4) Average of 1, 2, and 3. (5) Average Deccan basalt, H. S. Washington's analyses, 4, 12, 13, 15, 16 and 23 in *Bull. Geol. Soc. Amer.*, 1922, 33, 774. (6) Average spilite, *Geol. Mag.*, 1930, 67, 9.

Ilmenite, too, has been altered to leucoxene. Ophitic and sub-ophitic textures are well developed.

Three chemical analyses of the Bijawar quartz-dolerites (Nos. 1, 2 and 3) and their average analysis (No. 4) show that there is not much chemical difference between the Bijawar quartz-dolerites and Deccan basalt (No. 5) except that the percentage of Na_2O is considerably higher in the former (6·02 per cent.) than that in the latter (2·27 per cent.).

The percentages of silica, alumina, ferrous oxide, lime and magnesia in the average analysis of the Bijawar quartz-dolerites compare well with those of the same constituents in the Deccan basalt. Richness in alkali is a remarkable chemical feature of the Bijawar quartz-dolerites.

Except for the percentages of CaO, MgO and TiO_2 the analyses of the Bijawar quartz-dolerites compare fairly well with an average analysis of spilite (No. 6). In containing a high amount of soda and low percentage of potash, the Bijawar rocks exhibit some of the important chemical characteristics[2] of spilites.

TABLE II.

Chemical Comparison between Bijawar, Gwalior and Singhbhum Dolerites.

	T/1	T/2	T/84	T/86	T/59	T/14	7	8	9
SiO_2 ..	51·15	49·20	49·90	50·82	50·27	49·76	50·18	50·27	51·37
Al_2O_3 ..	12·20	11·20	11·11	13·06	11·32	11·51	11·73	12·31	14·61
Fe_2O_3 ..	2·70	1·92	2·59	1·24	1·74	1·90	2·02	2·35	·90
FeO ..	11·66	12·24	12·10	10·27	12·38	12·96	11·94	9·79	9·87
CaO ..	9·85	10·76	10·34	10·20	10·05	9·08	10·05	10·05	8·72
MgO ..	5·38	6·02	5·25	5·80	5·68	4·58	5·45	6·12	6·01
Na_2O ..	4·07	4·06	5·17	3·69	5·07	4·75	4·47	6·02	3·24
K_2O ..	·58	1·24	·84	1·01	1·06	·94	·95	·88	1·36
TiO_2 ..	·99	1·65	1·05	2·24	1·09	2·50	1·59	1·18	·89
P_2O_5 ..	·76	·47	·44	·86	·75	1·14	·74	·30	·13
MnO ..	·36	·45	·75	·48	·38	·56	·50	·08	·12
$H_2O(+)$ ..	·46	·78	·75	·67	·49	·52	·81	·79	2·34
$H_2O(-)$ ..	·24	·17	·20	·19	·26	·16		·16	·07
CO_2 ..	..	..	..	..	..	..	..	..	·29
S ..	..	..	..	..	..	..	..	..	·04
TOTAL ..	100·40	100·16	100·49	100·53	100·54	100·36	100·43	100·30	99·96

T/1, T/2, T/84, T/86, T/59–Quartz-dolerites and T/14 Basalt–from neighbourhood of Gwalior. Analyst: M. P. Bajpai, *Jour. Geol.*, 1935, **43**, No. 1, 69. (7) Average of the six Gwalior rocks. (8) Average of three Bijawar quartz-dolerites. (9) Newer dolerite from N.E. of Belma. Analyst: L. A. N. Iyer, *Rec. Geol. Surv. Ind.*, 1932, **65**, pt. 4, 528.

The quartz-dolerites from Gwalior, which have been previously studied[3] by the author, and those from Bijawar are composed of the same mineralogical constituents. The presence of micropegmatite and ophitic and sub-ophitic textures, and indications of late crystallisation of iron oxides are three very important microscopic characters common to the rocks from both the areas. Table II shows that, as far as the percentages of silica, alumina, ferric oxide, magnesia and lime are concerned, there is a close chemical agreement between the Gwalior and Bijawar quartz-dolerites. It has already been shown[4] by the author that the Gwalior trap contains a higher amount of soda than the Deccan basalt. High soda content in the Gwalior and Bijawar rocks, together with fairly uniform percentages of other constituents, indicate a close relationship between them. Average soda in the Gwalior trap is 4·47 per cent. and that in the Bijawar dolerites 6·02 per cent. The maximum amount of soda in the Gwalior and Bijawar rocks is 5·17 per cent. (No. T/84) and 6·33 per cent. (Table I, No. 2) respectively. The relatively higher amount of soda in the Bijawar quartz-dolerites seems to be related with their highly altered state because in other respects they closely resemble the quartz-dolerites of Gwalior.

Holland, in his paper, " On some Norite and associated basic dykes and lava-flows in Southern India" has shown that the trappean rocks which are found associated with the Gwaliors and Bijawars remarkably agree[5] with the augite-diorites of the Cuddapah lava-flows in petrological characters. A chemical study of the rocks from Gwalior and Bijawar shows that richness in alkali seems to be a regional feature of these supposed equivalents of the Cuddapah

lavas. Recently L. A. N. Iyer has described some "Newer dolerites" from Singhbhum which also resemble[6] Holland's augite-diorites. It is interesting to note that they also show alkaline tendencies, the total of soda and potash being considerably high in all the analysed[7] specimens of the Newer dolerites. Iyer's specimen from Belma is particularly rich in alkalies (Table II, No. 9).

The Bijawar quartz-dolerites contain an abnormally high amount of soda. An advanced stage of decomposition of their plagioclase felspars arouses suspicion that the enrichment in soda is probably due to the partial albitization of the original labradorite felspar. The felspars (with their decomposition products) and the pyroxene are under detailed investigation.

M. P. BAJPAI.

Department of Geology,
Benares Hindu University,
June 10, 1935.

[1] *Mem. Geol. Surv. Ind.*, **2**, 43.
[2] *Geol. Mag.*, 1911, **43**, 205.
[3, 4] *Jour. Geol.*, 1935, **43**, 61–75.—On page 69 of the Journal two mistakes have unfortunately occurred in the statement of analyses of the Gwalior trap. The value for MgO in T/14 is 4·58 and not 5·58 as printed, and the values shown against H_2O (−) are those of H_2O (+) and *vice versa*. The author has taken this opportunity of correcting these mistakes and revising the average analysis in Table II of the present communication.
[5] *Rec. Geol. Surv. Ind.*, 1897, **30**, 36-37.
[6] *Rec. Geol. Surv. Ind.*, 1932, **65**, 530.
[7] *Rec. Geol. Surv. Ind.*, 1932, **65**, 528.

Sir Montagu Webb and Silver.

SIR MONTAGU WEBB has drawn my attention to what he describes as one little inaccuracy on page xi of my paper on "Energy and Economics"[1]. I represented him as having *put aside for a time* his advocacy of an increase in silver currency. He writes that he is, as a matter of fact, pressing with greater vigour than ever for co-operation with President Roosevelt in re-opening the world's mints *to the people* to the free coinage of *unlimited legal tender silver coins*.

Actually I had no intention of suggesting that Sir Montagu had in any way abated his campaign. I merely meant that in the particular case of Karachi, silver was not specifically mentioned. If I had said "for the moment" instead of "for a time" it might have better conveyed my meaning. In any event I am glad to have the opportunity of correcting a possible false impression.

I may mention that Sir Montagu has just sent me the first five numbers of his new bulletin entitled "*Better Money*" which are full of valuable information on the subject of Monetary Reform. He tells me that he will be glad to send copies to any student of this, the most important problem of the day.

GILBERT J. FOWLER.

Central Hotel,
Bangalore,
June 26, 1935.

[1] *Curr. Sci.*, 1935, **3**, No. 11, Supplement.

Magnetic Susceptibility of Ice.

IN a letter[1] regarding the diamagnetic susceptibility of water polymers, the susceptibilities of (H_2O), $(H_2O)_2$ and $(H_2O)_3$ have been computed using the temperature-susceptibility data of Cabrera and Fahlenbrach and the polymer abundance data at different temperatures obtained by Ramakrishna Rao. The computed value for the susceptibility of ice works out to be $-0{\cdot}7080 \times 10^{-6}$. At that time I was not aware of any experimental value for the susceptibility of ice. Recently, however, my attention has been drawn to a paper by Ishiwara[2] where the susceptibility value for ice is given as $-0{\cdot}699 \times 10^{-6}$. The calculated value shows a deviation less than 1·5% from the observed value; this in itself is a striking agreement in support of the theory. Ishiwara has further observed that the susceptibility of ice remains unaltered between −120°C. and 0°C. This would require the polymer constitution of ice to remain fairly constant between −120°C. and 0°C. It is quite probable that in ice no variation occurs, for it would demand a rearrangement of the crystal lattice. Modifications of ice, *viz.*, ice II, III, V and VI observed by Tammann and Bridgman at low temperatures and very high pressures are perhaps due to this cause. But ice I, *i.e.*, ordinary ice, cannot possibly be modified by the lowering of temperature alone. Such a hypothesis would explain the observed constancy of the magnetic susceptibility of ice between −120°C. and 0°C. at atmospheric pressure. It must, however, be admitted that the above assumption requires experimental confirmation.

L. SIBAIYA.

Department of Physics,
Central College,
Bangalore,
July 8, 1935.

[1] *Curr. Sci.*, 1935, **3**, 421-22.
[2] *Rep. Tohoku Imp. Univ.*, 1914, **3**, 303.

Chemistry in the Customs Department.*

By H. B. Dunnicliff,

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INTRODUCTION.

IN 1905 the attention of the Government of India was drawn to the inferior quality of country spirit consumed by the Indian people and Lt.-Col. (afterwards Sir Charles) Bedford, I.M.S., was appointed to investigate matters. Assisted by Messrs. Jenks and Day and two Indian Laboratory assistants, he carried out the pioneer work in India on spirit examination and estimation. They studied the contamination of spirits with copper and zinc and prescribed easy tests for their detection. They also developed methods for distinguishing between illicit spirits and those distilled under Government permits, mainly by the detection of common impurities present, and prepared an official Technical Excise Manual. This work had the dual effect of improving country spirits and conserving excise duty.

DETERMINATION OF SPIRIT STRENGTH.

The term "Spirits" was used to mean the compound which is most commonly produced in fermentation processes and which is properly called "ethyl alcohol" or more commonly just "alcohol". Ethyl alcohol is, however, only one of a series of compounds having similar or related properties and the term "Spirits," both in Great Britain and India, now includes pure methyl alcohol which is produced in large quantities by several commercial processes.

In India, the term "Spirits" covers all alcohols the proof strength of which can be readily ascertained. Such alcohols must be miscible with water in all proportions and, at a temperature of 51° F. have, in the pure state, a specific gravity relative to water of not more than 0·923. These conditions are satisfied by methyl, ethyl, normal-propyl and isopropyl alcohols.

The spirit strengths are determined by two methods, the hydrometer and the pyknometer or specific gravity bottle.

Sikes Standard Brass Hydrometers were originally used but Sir Charles Bedford stated that they are not very suited to Indian conditions and he prepared tables for the use of instruments made of glass and, in a simple mixture of alcohol and water, the amount of alcohol present can be determined directly by these instruments.

If, however, some other substance is present in solution, such as sugar or colouring matters, the direct reading of the instrument no longer gives the spirit strength and the spirit strength is said to be "obscured" by these additional substances. Obscuration always results in an apparent lowering of the amount of alcohol present and consequently in the loss of revenue if not properly calculated and adjusted. Its determination in alcoholic liquors is one of the important functions of customs and excise chemists.

In obscured liquids, spirit strength is determined by distilling off the alcohol and finding the spirit strength of the distillate by the hydrometer or pyknometer. In some cases, the distillate contains substances other than spirit such as essential oils or volatile compounds like camphor and these have to be separated before the correct spirit strength can be reported.

For some years spirit strengths were determined in the Gauging Departments of Custom Houses and Mr. Jenks who, until 1928, was Chemical Examiner for Customs and Excise at the Calcutta Custom House was called upon to investigate and report on the best method for the determination of the spirit strength and obscuration of spirituous liquors imported into India.

The United Kingdom procedure using the Sikes brass hydrometer was ultimately adopted and all ports have their instruments adjusted at Calcutta where there are standard instruments, which are periodically tested at the Government Laboratory in London.

DENATURATION.

Alcohol is an essential constituent of many commercial articles such as "methylated spirits", varnishes, a number of medicinal preparations and many others.

In order that alcohol may be available for arts and industries as well as for domestic purposes, it must be cheap but it must be "denatured," *i.e.*, made too unpleasant to drink. Hence much work has been done to discover suitable substances to add to drinkable pure or nearly pure alcohol, the so-called "rectified" or "silent" spirits, to make them so nauseating and repulsive that even the strongest palate could not tolerate the taste. Substances added to pure alcohol for this purpose are called "denaturants".

The selection of an official denaturant for India was investigated by Sir Charles Bedford and Mr. Jenks with the co-operation of Messrs. D. Waldie & Co.

The properties required of an ideal denaturant are very exacting and may be detailed as follows. It must be a combustible volatile liquid, soluble in alcohol, having an unpleasant taste and smell and not be easily separable from the spirit by physical or chemical means. It must not be poisonous nor have any injurious effect on the human body and must be available in large quantities at low rates.

Very few substances have all these properties and a fortune awaits the discoverer of new and better denaturants than those at present available.

Spirit is denatured in India by the addition of two substances: the first is one of the distillation products of old vulcanised rubber, such as old motor tyres, and is called "light caoutchoucine," the other is "pyridine bases of mineral origin". (Pyridine bases can be made from animal nitrogenous refuse but their use is not permitted.)

One half per cent. of each of these substances is added to imported rectified spirits in the Custom Houses before the spirit is issued for general use as "denatured spirit" or, as it is often erroneously called "methylated spirit".

* An abridged version of a public lecture given at the meeting of the Twenty-Second Indian Science Congress on January 5th, 1935, in the Senate Hall of the Calcutta University.

Denaturation by other means, such as the addition of wood naphtha, is only allowed by special permission in the interests of the development of certain industries and in the case of certain IMPOTABLE preparations. Such denaturants "earmark" the spirit as "specially denatured" and the chemist is responsible for their detection.

PROOF SPIRIT.

The way in which alcoholic content is described, *i.e.*, in terms of "proof spirit," has a peculiar origin. If a light is put to alcohol, it will burn, even when it contains fairly large quantities of water. In early days, if a specimen of alcohol was poured over gunpowder and then ignited, the alcohol was said to be "under proof" if the flame ceased burning without igniting the gunpowder and "over proof" if, under these conditions, the gunpowder burst into flame. The weakest solution which just permitted the gunpowder to inflame was called "proof spirit". The strength of this spirit was accurately determined and spirit strengths are still described in terms of this arbitrary standard, *i.e.*, in degrees of proof spirit. A spirituous liquor is said to be 10° "under proof" if, from 100 volumes of that liquid, 90 (*i.e.*, 100 - 10) volumes of liquid of proof strength could be made. Thirty degrees "over proof" means that 100 vols. of that liquid could be diluted with water to give 130 volumes of proof spirit. One hundred volumes of pure alcohol would give approximately 175 volumes of proof spirit. Thus pure alcohol is 75° over proof. These values are sometimes described as percentages, for example, 30° over proof spirit is also said to be 130% proof.

POWER ALCOHOL.

One of the earliest investigations undertaken in the Customs Laboratories was an attempt to formulate a fuel for motor vehicles in an attempt to replace or supplement petrol. The Power Alcohol Committee appointed Mr. Jenks to carry out experimental work and he finally submitted proposals for the introduction of a fuel composed of 90% alcohol, if not less than 55° over proof, denatured with the usual denaturants and coloured with half a gram of methyl violet per gallon together with 10% of petrol, ether, benzol or other approved adjunct to act as anti-knock constituents.

ISOPROPYL ALCOHOL.

Complexity sometimes arises because the Government of India's definition of "spirit" differs from that of Great Britain in that it includes two more alcohols, normal and isopropyl alcohols. The former is not of much importance but the latter, isopropyl alcohol, called by various trade names such as "avantine," "petrohol" etc., causes difficulties as it is being used in increasing quantities in the manufacture of cheap perfumes, flavouring essences, toilet preparations and a number of other commercial products. Since this compound is not classed as "spirit" in England, cheap scents and other products like flavouring essences are often described in good faith as "free from spirit" while they contain isopropyl alcohol and, are therefore assessed to spirit duty on import into India.

Recently it was discovered that the standard chemical method for the determination of spirit strength known as the Thorpe and Holmes's method, is not reliable when isopropyl alcohol is present and a modified* form of the test has been worked out by two chemists at the Bombay Custom House and is in current use

WINES, ETC.

Some alcoholic beverages, *e.g.*, beer, porter, cider, are not tested directly, but they have to be identified. Wines not containing more than 42 degrees proof spirit, roughly 24% by vol. of alcohol, and perfumed spirits or scents are assessed by volume or gallonage.

Wines containing small quantities of medicinal substances are called "Medicated Wines". For Tariff purposes, they are assessed at a lower rate of duty than that charged on ordinary beverages containing spirit and they are classed in a separate category although, fundamentally, there is little difference between a medicated and a beverage wine. Wines containing very small quantities of medicinal substances are also sold as "aperatif wines" and claims are sometimes made for their preferential treatment as medicated wines. This is not permissible in Customs although Excise regulations allow them to be sold under a medicated wine licence in chemists' shops. An up-to-date list of medicinal, aperatif and beverage wines is maintained in all Custom Houses.

PROHIBITED AND RESTRICTED DRUGS.

Alkaloids such as morphine, cocaine and other habit-forming drugs have valuable medicinal properties and their total restriction is not desirable. The Health Committee of the League of Nations is attempting to regulate the traffic in such drugs without interfering with their use in medicines. In addition to these, a number of valuable restricted and prohibited drugs have been synthesised and the qualitative and quantitative examination of samples in pursuance of the Geneva Convention for the Regulation of Narcotic Drugs of 1925 and in the operation of the Dangerous Drugs Act is among the important duties of Customs analysts.

THE DEVELOPMENT OF THE CUSTOMS LABORATORIES.

Until 1912, the main commodity assessed to Customs duty by chemical means was "spirituous liquors". These were tested in the Custom Houses but any other imports requiring chemical examination were sent to the laboratories of the Chemical Examiners to the Local Government of the Presidency in which the Custom House was situated.

As time went on, the number of articles requiring chemical examination to provide for their correct assessment to Customs duty and the number of samples submitted increased and the complexity of the issues became more involved.

To deal with the work, a laboratory having a wider scope was opened in the Calcutta Custom House and Mr. Jenks was appointed to do all the excise work for Local Governments (except Bombay and Madras) and also to examine any Customs samples which might be submitted.

Further increase in the number of items in the Customs Tariff assessable to duty on the basis of chemical examination took place during the next fourteen years, until the range extended over foods, textiles, oils, building materials, jewellery, paper, minerals, dyes, patent preparations of all kinds and numerous other classes

*Vide *Analyst*, 1935.

of goods and the necessity for a specially trained scientific staff became self-evident.

In 1926, the Government of India decided that it would be advisable to consider the establishment of laboratories in the Custom Houses at the other major ports: Bombay, Karachi, Madras and Rangoon, so as to expedite the work and have the testing carried out under the administrative control of the Collectors of Customs.

Mr. Jenks was directed to submit a scheme and, in 1927, laboratories at the Karachi and Rangoon Custom Houses were opened but the apparatus was limited and the equipment incomplete.

Mr. Jenks was put on special duty in 1928 to organise, furnish and equip the laboratories, to make recommendations regarding staff and to prepare a technical manual for the use of Customs chemists. Unfortunately, he suddenly fell seriously ill in July 1928 and had to leave India immediately.

His senior assistant Mr. (now Rai Sahib) M. N. Ghose, the present Chemical Examiner at the Calcutta Custom House, was put in charge of the laboratory but, in the following October, the Government of India appointed a special advisory officer to develop the scheme for the organization of Customs chemical work.

Laboratories suitably equipped for the purpose and staffed by qualified chemists have been fitted out in the Bombay, Karachi, Madras and Rangoon Custom Houses and the equipment at Calcutta expanded and improved. These laboratories are responsible for the testing of all samples sent for examination by the Appraisement and other Departments of the Custom House and the chemists in charge submit their reports, paying special attention to the interpretation of the Indian Customs Tariff. Each laboratory works under the direction of a Chemical Examiner or Assistant Chemical Examiner. These officers are under the administrative control of the Collector of Customs at the port and the technical control of a Central Officer entitled the Special Chemical Adviser to the Central Board of Revenue. At present, by the courtesy of the Punjab Government, that officer is located temporarily at Lahore where excellent laboratory and library conditions exist. From this Control Laboratory, standard methods of analyses are circulated, investigations are carried out and appeal cases and technical references are submitted for advice or discussion. All laboratories periodically send remnant portions of actual samples for comparative analysis, criticism, information and report. The Indian Customs Tariff is divided into ninety-one general items of which eighty-seven are in the Customs Tariff under twenty-two sections. Samples under more than half of these eighty-seven items can be submitted to the laboratories for test or opinion. When one considers the practically unlimited range of imported articles, a moment's consideration will give an idea the wide scope of chemical knowledge demanded of the Board's chemists if revenue is to be safeguarded. The Special Chemical Adviser visits all the Board's laboratories at least once a year and is in frequent personal contact with the Central Board of Revenue on scientific matters.

In addition to the routine work, the chemists contrive to find time to investigate new methods or modify existing ones in the interests of speed and efficiency and several articles on analytical and other subjects have been published in scientific journals. This phase of activity shows that the chemists take a lively interest in their duties and are anxious to keep in touch with or even in advance of accepted technical procedure. Though the duties of Customs chemists deal mainly with the examination of imported goods in order to allocate them to the correct items of the tariff, the work in the Custom Houses covers a still wider field.

MERCHANDISE MARKS ACT.

From time to time, samples are submitted for test to find out if they are correctly described. Importers of goods which are marked with inaccurate or misleading descriptions are liable to penalties under the Merchandise Marks Act.

For example, bottles of medicine such as quinine, stated on the label to contain a specified amount of the drug, may be found to be deficient in the essential constituent; pen nibs or gold or silver articles may be marked incorrectly as to their composition, *e.g.*, pen nibs may be marked 9 Kt. gold and found to be only gold washed; condensed milk stated to be made from full cream milk may be found to be made from skimmed milk; artificial butter or ghee described as "vegetable product" may be found to contain animal fat or hardened fish oil, etc. A wide range of textile goods and many other articles are submitted for test under this head.

Calcutta is the only laboratory which does Excise work for the Government of India and certain Indian States. A good many samples of fibres such as jute, hemp, sisal, aloe, flax, etc., are also examined for allocation to various items of the Import or Export Tariff.

CONTRABAND.

Another interesting function of the laboratories is the examination of contraband, such as opium and other restricted drugs such as cocaine, known to addicts as "snow", and the testing of certain imports under the Explosives Act or the Dangerous Petroleum Act. Matches are examined for yellow phosphorus and crackers for potassium chlorate and gunpowder.

If contraband opium is found to contain 3 per cent. of its most important alkaloid, morphine, it is sent to the Government Opium Factory at Ghazipur for the manufacture of morphine, codeine, etc., otherwise it is destroyed at the port. Cocaine which is seized by the Customs Preventive staff is kept in bond under an armed guard and a special chemist has been trained to manufacture from the contraband cocaine pure B.P. cocaine hydrochloride which is sold to Government Medical Departments or to other purchasers approved by Government for use in medicine and surgery. The impurities with which the drug is diluted, so that swindling in its illicit sale may be carried on, include synthetic drugs like aspirin and phenacetin and such commonplace substances as starch, Epsom salts or sugar.

SALT.

Originally the analyses of salt samples for the Salt Revenue Department were tested in the laboratories of the Chemical Examiners to local Governments but now all Government salt samples are tested in the Customs Laboratories and, during the non-co-operation movement in 1930, all samples of satyagraha salt were tested in the Board's Control Laboratory—the principal concern of Government being as to whether the

products contained impurities dangerous to human life. Salt is sometimes exempted from duty when used for certain manufacturing processes if it is rendered unfit for human consumption by "denaturing" it with napthalene or "hypo".

Salt imported and issued with the previous sanction of the Governor-General in Council for use in certain manufacturing processes such as glazing stoneware or curing fish is allowed to enter India duty-free.

FUMIGATION.

This extensive country is inflicted with many pests which seriously hinder agriculture and Government is very anxious to prevent the introduction of any new varieties. Hence, all imported living plants and certain seeds have to be disinfected at the ports by fumigation with prussic acid vapour before being sent to their consignees.

TRAINING OF YOUNG CHEMISTS.

From time to time one or other of our laboratories has been responsible for the training of chemists for special purposes and it is now decided that the laboratories of the Central Board of Revenue shall undertake certain testing work for certain other Government Departments, for example, the examination of oils for Indian Railways to enable them to classify them correctly under the various freight rates.

KINDS OF DUTY.

In general, Customs duty can be classified under three heads :—

1. Duty imposed purely for *revenue* purposes. This duty is levied on all goods whatever their country of origin.

2. *Preferential Revenue.*—This is collected for revenue purposes but there is a concession of part of the duty, usually 10 per cent. less for the United Kingdom or a British Colony or both, so as to give privilege to constituent countries of the British Empire. These preferential tariffs which have come into being as a result of the Ottawa Agreement have increased the analytical work because certain imports not previously chemically examined have now to be tested in the laboratory.

3. *Protective Duty* is the duty levied on goods imported into India with a view to safeguarding India's industries. Among these items are cheap printing paper, raw silk and silk waste and textiles containing specified percentages of certain constituents such as cotton, silk, artificial silk, etc., all of which have to be checked by chemical examination.

YARNS AND TEXTILES.

Yarn and textile fabrics yield a considerable amount of Customs duty. In 1930 and 1931, textiles made of artificial silk were assessed at a lower rate of duty than cotton piece-goods. Artificial silk was often substituted for cotton in imported piece-goods. This put Indian cotton manufacturers at a disadvantage, particularly on account of the attractiveness of artificial silk textiles and because artificial silk was not manufactured in India. To protect the Indian cotton industry, the Government of India increased the duty on artificial silk to a rate much higher than that on cotton goods.

Owing to foreign competiton, particularly from Japan, the Government of India has now levied protective duty on all kinds of piece goods and this has materially increased the analytical work as will be understood from the following examples, the classification of all of which depends on chemical examination ; the fibres mainly concerned being cotton, wool, silk and artificial silk and the difficulty of the work is much increased by the introduction of many classes of composite fibres.

Fabrics containing gold or silver thread are assessed at 50 per cent. *ad valorem*, whatever the rest of the material is made of. Fabrics not otherwise specified containing more than 90 per cent. artificial silk are assessable at different rates depending on whether they are or are not of British manufacture.

Woollen fabrics not otherwise specified containing not more than 90 per cent. wool, excluding felt and fabrics made of shoddy and waste wool, made in the United Kingdom are on the preferential list. Their examination involves (*a*) determination of wool and (*b*) the decision as to whether the wool is waste or shoddy.

Other items requiring reports from the laboratories are :—

Cotton fabrics not otherwise specified containing more than 90 per cent. cotton ; fabrics not otherwise specified containing more than 10 per cent. and not more than 90 per cent. silk ; the distinction between pure silk and silk noils and waste silk and many others.

While certain antimalarial alkaloids are imported free of duty, it is difficult to get the same privilege for any substance imported under a trade name for the same benevolent purpose. For instance, Paris Green, a basic arsenite of copper, is used for antimalarial purposes but, as it is employed in other industries, for example, as a pigment, it has to pay duty.

A number of painters' materials are examined, *e.g.*, genuine red lead, genuine white lead and genuine zinc white which have to conform with certain specifications and must be distinguished from the "reduced pigments" or pigments to which a cheaper material has been added to lower the price such as the mixing of barium sulphate with white lead or zinc white. A large variety of pigments are submitted for test including compounds of less common metals like zirconium, tungsten, etc. Manures, chemicals and various technical chemical products often furnish interesting chemical investigations.

MILK AND MILK POWDER.

Condensed milk and milk powders are liable to adulteration and milk products are analysed to find out if the original milk from which the condensed milk or milk powder was made contained the requisite percentage of fat. It is also important to know if other constituents have been removed and complete analyses are sometimes required to ascertain the protein or lactose values of the original milk.

DYES, ETC.

Synthetic dyestuffs made from coal-tar products and coal-tar auxiliaries used in dyeing have been included among dutiable goods. In 1927, as the result of a representation of the cotton mill owners, the Government of India abolished the duty but, in 1932, it was restored and, since then, coal-tar dyes and substances derived from coal-tar used in dyeing processes are assessed to duty at 10 per cent. either *ad valorem* or on different tariff values.

Customs chemists are required to find not only

the class to which a particular dye or auxiliary belongs, but sometimes to identify the substances as well. They are also required to test insoluble dyes, coal-tar lakes and other coal-tar pigments used for the manufacture of printing ink, etc., and which are assessed under a separate heading.

PLATED ARTICLES.

To encourage the electro-plating industry in India, a preferential duty has been imposed on electroplated articles, but the term "electro-plating" has caused a good deal of trouble. Ordinarily it means a coating of noble metals like gold or silver on base metals, but there are cheap gold- and silver-washed articles as well as cheap jewellery which cost little and are showy but, on use, rapidly deteriorate and soon show the base metal foundation. The term "electro-plated" signifies articles having a "durable" coating of gold or silver and the criterion of "durability" has often presented difficulties. The words "gilt" or "rolled gold" are often stamped on such goods and the customs chemists are required to test them to detect violations of the Merchandise Marks Act and also to make the difficult decision in border line cases between gold-washed and gold-plated articles.

HYDROCARBONS.

Much work is sent to the laboratories under what may be called " petroleum products " or "hydrocarbons". This includes a wide range of commercial articles, commencing with dangerous petroleum and finishing with tar and other building and road-making materials derived from petroleum or coal. The appraisers also submit a wide range of lubricating oils and greases as well as fuel and kerosene oils and other illuminating oils for examination and report.

PAPER.

An item of the tariff which has caused a great deal of work is printing paper known as "cheap newsprint", containing not less than 70 per cent. of mechanical wood pulp. The other constituents are usually chemical pulp and loading and finishing materials. The analysis is carried out in two ways: (1) optical and (2) chemical. The former depends on the fact that mechanical wood pulp is stained yellow and chemical pulp is stained blue by iodine. The fibres are counted under the microscope. The chemical method depends on the fact that a constituent of mechanical wood pulp combines with phloroglucinol. The well-known method of Cross and Bevan has been standardised to Indian conditions in the Control Laboratory.

Sometime ago, starch could be imported duty free but now it is liable to duty of 15% *ad valorem* while flour or farinaceous food is dutiable at 25% *ad valorem* (except tapioca flour which has a Tariff value and necessitates its distinction in the laboratory from other flours). Since "corn-flour" is practically pure starch, one has to decide under which head this has to be assessed. This is a function of the Collector of Customs but presumably he is driven to consider in what manner it is imported; in packets labelled as some sort of foodstuff, or in sacks, presumably for the textile or other industry, possibly to be packeted as a food later on after having paid the lower rate of duty!

Similarly toilet soaps and household soaps are assessed at different rates of duty.

A variety of "toilet preparations" are submitted for test and the high content of liquid paraffin or other mineral oil which occurs in some so-called "pure vegetable oil" hair preparations is surprising.

In these days of artificial products, many essential oils are made up of or synthesised from manufactured constituents and the distinction between the natural and the synthetic oil is one which presents considerable difficulty.

The complexity of the customs chemical work increases daily as the development of synthetic preparations for various industries increases. The identity of these compounds is hidden under non-committal trade names such as Kaffir Plaster, Kasenite, Lactoyd Sheet, Cremol, Ramasit, Pernisol, Purgatol, Asplit, Priemsal, Suma Carb, Ursol, Vimto, Silica sel and sometimes without any name or suggestive description. The composition of these patent preparations cannot be given for obvious reasons but such imports have to be examined in order to advise the Collector of Customs as to which item of the Tariff is involved. About 35,000 samples are examined annually but this gives no idea of the range of the work since, as will be seen from the examples quoted, the examinations are often of a complicated and specialised character.

It not infrequently happens that inter-portal discussions are involved and much investigation undertaken in order to define the category of a particular importation. This can scarcely be avoided owing to the want of precise definitions of many articles of commerce. This difficulty is overcome in various ways, often adopting certain limiting criteria which define the product, but it is clear that those limits must be finally acceptable to the trade before applying them to the material in question.

It will thus be seen that the work of the Customs chemists demands qualified analysts of more than ordinary ability and that Chemical Examiners must have a wide knowledge of the application of the products examined so that, on the one hand, revenue may be safeguarded and, on the other, business interests may get a fair deal.

With the exception of the writer, there are twenty-seven chemists working in the Board's Laboratories, all of whom are Indians and great credit is due to them for their honest and successful work in a difficult and critical field which yearly increases in scope and complexity.

Some Biochemical Factors of Disease Resistance in Plants.

By A. V. Varadaraja Iyengar, D.Sc., A.I.C., A.I.I.Sc.

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THE ability of plants to withstand the effects of extremes of climate or the invasion of parasites is a highly variable quality. Thus, it is common to find a few plants which are able to resist these extraneous influences for considerable lengths of time while others succumb readily. The occurrence of such resistant types has been made use of by botanists, physiologists and plant breeders for diverse purposes. The factors that contribute towards this capacity are of much practical importance and may be classified under the two main heads :—(*a*) morphological or structural, and (*b*) physiological or biochemical.

Our knowledge of disease resistance is derived mainly from animal pathology, in which rapid advances have resulted in the development of immuno-therapy, leading to the protection of individuals from infection. The applications of serum-therapy, chemo-therapy and vaccines are the outcome of researches in the above field. Unfortunately, these procedures do not lend themselves to such fine manipulation with plants as in the case of animals. The reason for this lies in the essential difference between the two groups indicated by Quanjer,[1] Blackman[2] and considered in detail below. In the first place, the nature of immunity itself varies in both the cases. Thus, while acquired immunity plays a large part in protecting animals including human beings from external infection, natural immunity is the most important factor in vegetable life. Secondly, the existence of a circulatory system in animals makes possible the movement of blood to the distant organs, in consequence of which an infection is followed by a general bodily reaction. In plants the lack of such a system is perhaps mainly responsible for the localisation of disease for considerable lengths of time. Again, the existence of this circulatory system in animals has rendered possible the utilisation of serum-therapy technique, whereby immunity acquired at one point is rapidly translocated to different points in the body to control infection. On the other hand, new organs are developing very rapidly in plants and immunity induced artificially at one point cannot be easily transferred to other parts. Even if such a process is conceived of, it is very much inferior to that of animals, and the anti-bodies formed in the older tissues are transmitted only with greatest difficulty to the constantly forming organs. It is obvious, therefore, that serum-therapy cannot be successfully applied to plants. Although this is true to a large extent, more recent investigations by Carbone and Arnaudi,[3] Nobécourt[4] and Chester have made[5] possible the application of vaccination technique in plant protection. In animals, moreover, general bodily reaction is so effective that acquired immunity lasts for considerable length of time, whereas in plants such immunity is not long-standing, and is subject to highly fluctuating external factors such as soil, climate and nutrient supply. Furthermore, while recovery from a disease protects normally an animal from subsequent attacks of the same malady, such recovery in plants does not necessarily immunise them from later invasions of the parasite. Lastly, instances of artificial immunisation of a susceptible plant with a weak or attenuated strain of a known virulent parasite are still rare—a phenomenon which is so successfully applied in the control of animal disease. The recent work of Kunkel[6] indicates the possibility of protecting plants from virus infection such as that of mosaic in tobacco and aucuba by inoculating them with attenuated strains of the infective principle. The effect of these is, however, visible on the plant, such as mottling, etc. Further work is necessary, therefore, to define the conditions of this process.

Nature of disease resistant factors.—The factors that control or modify infection by parasites (including viruses) are mainly two-fold :—(*a*) structural, and (*b*) biochemical. It is futile to separate the two, since the distinction between them is not well defined. It is important, however, to recognise that mechanical or anatomical features play a large part in preventing the parasite from gaining access into the plant tissue, while the physiological condition of the plant determines the establishment of nutritive relations between the host and the parasite. Thus, the plant juice exerts a direct biochemical influence on account of its immediate nutritive value in the early stages of infection. It is possible, therefore, that in some cases, the sap may not be quite suitable for the proper development of a parasite, while in others, the juice may constitute an ideal medium for the vigorous growth and rapid multiplication of the invader. It is sufficient to refer to the work of Zimmermann[7] in this connection. In the process of resisting their entry, plants may exude, by exosmsis, materials which may either hinder or help the regeneration of the disease producing agent. The application of poisonous chemicals externally through dusting and spray treatments is based on the above principle, whereby the poison is made readily available to the organism in the process of feeding on such plants.

Isolation of inhibitory substances.—In Cabbage rot Mallmann and Hemstreet[8] observed a liquefaction and subsequent dissolution of the entire tissue. The extract containing the dissolved material was highly active, even when considerably

[1] Quanjer, H. M., *Rev. Pathol. Vegetal. de Entom. Agric.*, 1923, **10**, 22.

[2] Blackman, *Brit. Assoc. Rept. Presid. Address to Section K.*, 1924.

[3] Carbone, D., and Arnaudi, C., *L'Immunita Nelle Piante*, Milano, 1930.

[4] Nobécourt, P., *Contribution a' l'etude de l'immunité chez les vegetaux* (Bailliere, Tunis), 1928.

[5] Chester, K. S., *Quart. Rev. Biol.*, 1933, **8**, Nos. 2 and 3.

[6] Kunkel, L. O., *Phytopath.*, 1934, **24**, 437.

[7] Zimmermann, A., *Centl. Bakt. Abt. II.*, 1925, **65**, 311.

[8] Mallmann, W. L., and Hemstreet, C., *J. Agr. Res.*, 1924, **28**, 599.

diluted, in inhibiting the action of the organism producing soft rot. The lytic principle of the extract resembles bacteriophage in this respect that its potency is not diminished by repeated transference of cultures. It will add greatly to our knowledge if further examination of the same is made. A similar principle was isolated by Wagner from plants infected with pathogenic bacteria.[9] Although this was precipitated by protein precipitants, like ammonium sulphate, its exact nature is still obscure.

Individual chemical compounds in relation to disease resistance.—Cook and Taubenhaus observed early that organic acids and tannins inhibited growth of organisms chiefly fungi (?). In their study on the toxicity of tannins, they showed that the capacity of the host plant to resist the entry of parasites was traceable to the presence of certain chemical substances rather than to structural differences. They assumed that tannins were responsible for this, but discovered that the fungi experimented with did not behave uniformly with tannins: some were more susceptible than others. Furthermore, sodium tannate was found to be less potent than tannin itself. It was therefore suggested that although tannins by themselves may not be chemotactic, their reaction would vary in association with and in presence of other substances occurring in plant cells, a view for which no adequate evidence is yet forthcoming. Subsequently, Cook and Wilson[10] confirmed the above observation in their investigation of the chestnut bark blight disease. Cook and Taubenhaus studied also the toxicity of vegetable acids and oxidising enzymes, in relation to fungi,[11] and showed that the development of root rots is traceable to an oxidase which acts on gallic acid in presence of oxygen to produce a tannin-like substance. This capacity diminishes on ripening, thus rendering the mature fruit more susceptible than the tender one.

Walker and his co-workers were the first to correlate resistance to disease with the occurrence of definite chemical entities. According to them, white variety of onions is highly susceptible to *Colletotrichum circinans* (Bark) which causes onion smudge, while yellow and red varieties are quite resistant.[12] In their subsequent studies they detected the presence of protocatechuic acid, *i.e.*, 3, 4, dihydroxy benzoic acid, in the outer scales of the resistant varieties alone. It was noticed that the concentration of this constituent was high in the resistant types, while it was entirely absent or was present only in traces in the white one.[13] These authors further recognised that the amount of the acid isolated may not represent the total concentration of this component. Moreover, the possibility of other compounds also adding to the resistance capacity has not been overlooked by the authors: but since they have noticed a definite correlation between the quantity of acid detected and the degree of pigmentation, *viz.*, the deeper the colour, the greater the amount of protocatechuic acid present, the above findings are of considerable significance. It may be remarked here that this substance is generally found to occur combined in catechol tannins, resins, gums and anthocyan pigments which are normally present in plants. Therefore it will be of great interest to know whether tannins play a part in disease resistance. In virus diseases of plants, including spike of sandal, no such correlation has so far been established. It is, however, of importance to observe that with the onset of spike, diseased leaves are found to contain more tannins,[14] among which the pyrogallol type is more predominant, while in the healthy or unaffected ones the catechol group of tannins is largely present. In a similar way, the colour of the bark shows distinct change to an intense brown colour as the result of spike infection.[15] To what extent, these factors aggravate or modify the insect attack or the visitations of the carrier of infection, is a problem of fundamental importance in the control of this disease.

Reaction of tissue fluid.—Comes first pointed out that the invasion of plants by fungi and other parasites was dependent on the sugar content and controlled by the acidity of the medium,[16] a greater sugar value and a low acidity of the juice being conducive to the rapid multiplication of the organism. He further observed that to this end, sugar and acids occurred in inverse proportions. Thus, low sugar content was correlated with high acidity and *vice versa*. This provides additional evidence to the observations of Cook[17] that the acidity is a natural defence against parasites. Unfortunately, however, the findings of Comes regarding the relation between sugar content and acidity could not subsequently be substantiated by either Mumford in his studies on curly top of beets[18] or, by the author from his investigations on the spike-disease of sandal.[19, 20] It is pertinent here to remark that increased acidity is a favourable condition for the formation of reducing sugars from disaccharides. Comes' observation of inverse relationship between sugar content and acidity is therefore difficult to explain. It may be that both are important factors and act independently.

Wagner studied the relation of reaction of plant juice to attack by parasites. He infected a number of plants with micro-organisms,[21] and observed an initial rise of 0.1 pH followed by a decrease in pH of nearly 0.6 units. Those plants that recovered from the attack reverted to normal and original acidity, while in those that succumbed, another rise was observed followed by a drop in pH when the tissues died. Harvey

[9] Wagner, R. J., *Centl. Bakt., II., Abt.*, 1916, **44**, 708.
[10] Cook, M. T., and Wilson, G. W., *New Jersey Agric. Expt. Sta. Bull.*, 1916, No. 291.
[11] Cook, M. T., and Taubenhaus, J. J., *Delaware Coll. Agric. Expt. Sta. Bull.* No. 91, 1911.
[12] Walker, J. C., *J. Agr. Res.*, 1925, **30**, 175.
[13] Walker *et al.*, *J. Biol. Chem.*, 1929, **81**, 369; **84**, 719.
[14] Varadaraja Iyengar, A. V., *Proc. Eighteenth Indian Sci. Cong.*, 1931, 284.
[15] Varadaraja Iyengar, A. V., (Unpublished).
[16] Comes, O., *Reale Istituto d'Incorraggiaments di Nxapole*, 1916.
[17] Cook, M. T., and Taubenhaus, J. J., *Ibid., Bull.* No. 97, 1912.
[18] Mumford, E. P., *Ann. Appl. Biol.*, 1930, **17**, 35.
[19] Varadaraja Iyengar, A. V., *J. Indian Inst. Sci.*, 1928, **11A**, 93, 103.
[20] Varadaraja Iyengar, A. V., *Ibid.*, 1929, **12A**, 295.
[21] Wagner, R. J., *Ibid.*, 1915, **42**, 613.

noticed a similar condition.[22] On the other hand, Hurd[23] could not correlate acidity in wheat, with resistance to disease. In sandal spike, the author (*loc. cit.*) observed that with the onset of disease, the reaction of leaf tissue fluid turns slightly more alkaline than that of the corresponding healthy ones but became more acidic with the advance of the disease. No apparent relation could be traced between sandal plants growing with different hosts. It may be concluded that acidity is not an important factor in the resistance of sandal to spike. Mumford examined beets which were susceptible or resistant to curly top. He could not detect any difference in the initial reaction of the juices of the two varieties.[24] Moreover, he found a greater concentration of total sap and of reducing sugars in the susceptible variety. This is however not in agreement with the observations of Carter, according to whom, the beet leaf hopper, *Euttettix tenella* Baker, which transmits this disease does not feed on plants which have a high sap concentration and this was used as an indication of resistance in beets.[25] The present author observed that in the advanced stages of spike a low pH value[19] is accompanied by the exclusive presence of succinic acid and by a characteristic diminution in oxalic acid.[26] Soluble sugars are also present in large quantities. In incipient stages, on the other hand, hydroxy acids are more prominent. These changes would appear to be traceable to the limited availability of calcium consequent on infection. The significance of these observations will be considered elsewhere.[27] Reynolds noticed that the growth of *Fusarium Lini* was depressed in an extract from wilt resistant flax, while in that of a susceptible one, it developed rapidly. The nature of the principle is still undetermined though evidences point to its glucosidic nature.[28]

It is well recognised that wild varieties of different species are more resistant to infection than cultivated ones. The factors involved in this are still obscure. Campbell[29] sought to induce immunity in cultivated applies to *Oidium farinosum* and to certain insects, through extra-radicate injection of weak solutions of tartaric, citric and malic acids. A similar treatment of sandal with malic acid prior to artificial infection through grafting did not impart any resistance to such plants.

Where acidity could not be correlated with immunity, attempts have been made to explain resistance to disease as being due to buffers occurring in plant saps. Ingold[30] could not, however, establish any relation between immunity and buffer index values in potato. Failure to tracing disease-resisting factors to initial acidity or to buffer values of the juice is due to the fact that these studies have been made on the expressed sap which may not represent the fluid actually present within the cells. Though spike disease induces abnormal changes in the buffering processes of sandal, Srinivasan and Sreenivasaya were unable to trace any striking difference in the buffers of sandal, grown in pots in association with different host plants.[31] It is difficult to reconcile this with Sreenivasa Rau's observation that the host plant associated with sandal determines the composition of the parasite.[32] Obviously factors like age, environmental factors play considerable part in the metabolic activities of sandal.

Enzymes in relation to disease resistance.—Though considerable amount of work has been reported on the enzyme content of plants as affected by disease in plants, no investigation has been conducted in relation to immunity to disease. Recently Suchorukov[33] found that peroxidase action was related to resistance to rust in *Helianthus annus*, *Artemisia* and *Xanthium* being lowest in the immune parts and individuals. On the other hand, catalase and proteoclastic enzymes were not found to play any part in the establishment of immunity. Alteration of the soil acidity affects peroxidase activity in the roots of sunflowers, the greatest depression of activity being observed in neutral soils. The presence of antioxidases or oxidase inhibitors could not be detected. Klotz observed that resistance to diseases was correlated with an inhibitory effect of the bark on certain enzymes produced by the fungi and suggested that similar inhibition of fungous enzymes by plant tissues might explain how certain plants resist the invasion of micro-organisms.[34] Since the relation of enzymes to disease resistance has still remained obscure, it will greatly add to our present knowledge if well known resistant types of plants are examined for their biochemical activities as compared with the highly susceptible ones.

Disease susceptibility and nutritional factors.—A large number of cases are known where it has not been possible to trace resistance to definite nutritive factors. On the other hand, striking evidence has been adduced to correlate nutritional deficit with the occurrence of disease. Further, as many plant diseases, particularly those of virus nature, are transmitted in nature through the agency of insects, the factors that determine insect attack should be of more practical importance. Spinks[35] drew attention to the fact that susceptibility to both mildew and rust in wheat as also to mildew in barley was enhanced by the availability of large quantities of nitrogen while application of potash showed a contrary effect. Plants which were semi-starved of nitrogen appeared to exhibit some immunity as also those to which lithium salts were applied. Lead and zinc salts did not appear to confer immunity. He thus established for the first time some

[22] Harvey, R. B., *J. Biol. Chem.*, 1920, **42**, 397.
[23] Hurd, A. M., *J. Agr. Res.*, 1924, **27**, 725.
[24] Mumford, E. P., *Nature*, 1930, **125**, 411.
[25] Carter, W., *Ecology*, 1927, **8**, 350.
[26] Varadaraja Iyengar, *J. Indian Inst. Sci.*, 1933, **16A**, pt. XIII.
[27] Varadaraja Iyengar, A. V., *J. Indian Inst. Sci.*, 1934, **17A**, pt. XII.
[28] Reynolds, E. S., *Ann. Mo. Bot. Gardens*, 1931, **18**, 57.
[29] Campbell, C., *Rend. R. Acc. Lincei.*, 1918, **5**, 57.
[30] Ingold, C. T., quoted by Small, J., "H-ion conc. in plant cells and tissues.—Protoplasma monograph No. II," 1929.
[31] Srinivasan, M., and Sreenivasaya, M., *J. Indian Inst. Sci.*, 1934, **17A**, pt. 13.
[32] Srinivasa Rau, Y. V., *J. Ind. Inst. Sci.*, 1933, **16 A.**
[33] Suchorukov, K., *Z. Opytn. Agron. Jugo-Vostoka*, 1930, **8**, 237.
[34] Klotz, *Science*, 1927, **66**, 631.
[35] Spinks, G. T., *J. Agr. Sci.*, 1912–13, **5**, 231.

chemical factors which determine susceptibility to disease in plants.

Subsequently Lees showed that water content of plants determines their relative susceptibility to insect pests.[36] According to him, several cases were noticed wherein insect attack was evident due to profuse irrigation or following heavy rainfall, it appears probable, however, that it may actually be a case of physiological drought due to defective soil aeration in spite of such large supply of water. In an earlier publication[37] Lees had shown that water and nitrogen contents were interdependent. A defective root system has invariably been recorded in diseased plants including virus infected ones. It is of great importance to correlate water balance as a factor of resistance to insect attack. Thus, it has been shown by Mumford that a disturbed water content rendered the cotton plant more susceptible to sap feeding insect pests.[24] A similar condition has been observed with sugarcane also: plants suffering from water shortage were found to be more attractive to the attacking thrips than those receiving the normal supply. Recently Mumford has analysed the different factors[38] and has classified them as being due to (*a*) morphological adaptations and (*b*) biochemical factors. The former may include, among others, the formation of thickened epidermis or cuticle or the development of hairs. In the latter case, the action may be due to some condition of the cell sap which will help to repel the invasion of insects or to the presence of substances such as certain essential oils, alkaloids or organic acids or that the composition of the sap may be so altered as to be quite unsuited to insects for their food requirements. The problem is highly complicated that a detailed study is necessary before any definite conclusion can be drawn. Carter has shown that an extremely high sap concentrations in beets are undesirable to and avoided by the sugar beet leaf-hopper, the carrier of curly top of beets, if more suitable food is available in the neighbourhood.[25] Mumford could not observe any marked difference between the varieties which are resistant and those which are susceptible to this disease. Similarly, Srinivasan and Sreenivasaya (*loc. cit.*) could not find any significant changes in the acidity of sandal grown in association with host plants which render the parasite highly susceptible to spike infection. It would appear that in this particular instance, lime is the chief predisposing factor and makes sandal highly prone to the disease since the calcium content of a plant is very high before it manifests symptoms of spike but shows a striking decrease with the onset of disease. Preliminary study on the rôle of lime on the apparent ease with which infection can be artificially transmitted to plants has indicated the harmful effect of this constituent in relation to disease transference.[27] Further evidence is adduced from the observations in diseased localities where application of lime to apparently healthy plants has not minimised the rate of spread of disease in them: in fact, it is significantly high in those cases. This is in conformity with the observation of Laurent[39] according to whom lime renders plants susceptible to diseases.

It will be clear from this short survey that no systematic study appears to have so far been carried out, of the biochemical factors of disease resistance in plants. The only entities that have been considered of any significance by the plant pathologist are the vegetable acids and tannins. Even here our knowledge is inadequate and much more yet remains to be done. It will be of great interest to know how these defensive mechanisms are brought about and the agency responsible for the same. It appears that the respiratory process as measured by the different oxidative activities, such as oxidases, peroxidases and catalase will throw considerable light on the subject. This is particularly so since acids arise also during respiration of the cell and tannins appear to enormously influence their action. Another useful line of inquiry may be directed towards the presence of certain rare minerals which modify the metabolic activities in a strikingly remarkable manner. The biochemical adaptations induced in plants, in consequence, would help to elucidate, many unknown and at present inexplicable phenomena. Certain experiments of a purely preliminary character, carried out by the author, indicated the possibility of employing such elements below their toxic concentration, to immunise plants against plant pathogens. Again, the feasibility of inactivating the causative agent, particularly a virus present in a diseased tissue without destroying the latter by suitable and careful administration of sublethal doses of plant poisons such as copper, arsenic, was tried in the case of spike[27] but could not be pursued further for diverse reasons. Lastly, a study of the mechanism by which certain constituents like water, nitrogen, etc., render plants highly susceptible to infection, will add vastly to our existing knowledge and will indirectly explain the process by which the attacked organism overcomes successfully the marauders of the invader.

[36] Lees, A. H., *Ann. Appl. Biol.*, 1926, **13**, 506.
[37] Lees, A. H., *Ibid.*, 1923, **10**, 35.
[38] Mumford, E. P., *Science*, 1931, **73**, 49.
[39] Laurent, E., *Ann. Inst. Pasteur*, 1899, **13**.

A Short Report on the Economic Value of *Artemisia* growing in the North-West Frontier Province.

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ARTEMISIA is very common in the North-West Frontier Province. Successful investigation of the Kurram *Artemisia* for the manufacture of santonin inspired great hopes of finding out additional sources of santonin in other parts of the country, where *Artemisia* resembling very much the Kurram material in appearance, grows in great abundance. It was therefore considered absolutely essential to carry out a thorough examination of the available material in these localities with a view to determining its economic value definitely. On the recommendation of Lt.-Col. E. W. C. Noel, C.I.E., D.S.O., the Director of Agriculture and Allied Departments, North-West Frontier Province, facilities were provided by the local Government for investigating promising regions in Waziristan, Tirah, Khyber and Malakand Agencies. Specimens and samples were collected from different localities at different times. The specimens were studied botanically and the samples were examined chemically for their santonin contents. The results of the findings are briefly mentioned below :—

(i) *Tirah, Khyber and Dir.*—*Artemisia maritima* grows in great abundance in the areas under review. It is very much similar to the santonin-containing *Artemisia* of the Kurram Valley in appearance but differs from it considerably in diagnostic characters. The full details of these characters will appear later. Samples were collected from different localities at intervals of a fortnight. They were examined for their santonin contents. Careful examination showed that the available material in these areas is commercially of no value as it contains no santonin.

(ii) *Waziristan.*—In South Waziristan, *Artemisia* is very abundant in the Wana plains, but the material in question is of no commercial value as it is without santonin.

In North Waziristan, *Artemisia maritima* is found at Datta Khel, Tut Narai, Shirina and Kazi. The areas in question are very small but the plant material growing in these areas contains a very good percentage of santonin. Samples collected during the end of September showed an average of 1·2 per cent. santonin.

(iii) *Chitral.*—*Artemisia* grows very abundantly throughout the country and forms a conspicuous feature of the indigenous flora. There are several species, the principal ones being :—(*a*) *Artemisia sacrorum* ; locally known as "Pispuk". (*b*) *A. scoparia* ; locally known as "Zia". (*c*) *A. laciniata* ; locally known as "Gudraun". (*d*) *A. Thomsoniana* ; locally known as "Daraun". (*e*) *A. maritima* ; locally known as "Maizini Daraun".

The chemical examination of several samples of each of *A. sacrorum*, *A. scoparia*, *A. laciniata* and *A. Thomsoniana* from different regions collected at different times of the growing period, showed that they do not contain any santonin.

Artemisia maritima collected from Drosh and its neighbourhood gave positive results, but the percentage of santonin is very low and is therefore not of much commercial value. It is, however, noteworthy in this connection that the samples submitted to chemical examination were not collected at the time when the plant contains the maximum amount of santonin. If the collections are made at the proper time, the percentage of santonin is very likely to show an increase.

The regions lying beyond Shaghour Valley on the East side could not be visited last year. The question of the economic value of *Artemisia* species growing there could not be taken up for want of time at the disposal of the writer. These regions have ecological conditions suitable for the occurrence of santonin-containing species of *Artemisia* such as *Artemisia brevifolia*, which grows abundantly in Kashmir and which, in certain selected areas, especially shows a good percentage of santonin. It is therefore very much desirable to carry on further investigations in this direction. This might ultimately lead to finding out species of *Artemisia* with a good percentage of santonin and establishing a permanent source of revenue for the Chitral State. A suitable area could then be selected for the cultivation and extension of the most desirable varieties of *Artemisia* for commercial purposes.

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[1] Clarke, C. B., *Compositeæ Indicae.*

[2] Duthie, J. F., *Records of the Botanical Survey of India*, Calcutta, 1898, **1**, No. 9.

[3] Qazilbash, N. A., *Bulletin des Sciences Pharmacologiques*, March 1935, No. 3.

Lady Tata Memorial Scholarships.

THE Trustees of the Lady Tata Memorial Fund announce that on the recommendation of the Scientific Advisory Committee they have made the following awards of scholarships and grants for the academic year 1935-36. These awards are open to suitably qualified persons of any nationality for research work in diseases of the blood with special reference to leucæmia. Scholarships: Dr. M. C. G. Israëls (Manchester), Dr. O. Kaalund-Jörgensen (Aarhus). Grants: Prof. W. Büngeler (Danzig), Dr. J. Engelberth-Holm (Copenhagen), Dr. Karl Hinsberg (Berlin), Dr. Ch. Oberling (Paris), Prof. Eugene Opie (New York), Dr. Lucy Wills (London).

"Discovery II" and The Exploration of the Whale's Habitat.

THE Royal Research ship "*Discovery II*" returned from Antarctic on June 3rd after completing her third commission. The expedition was of 20 months' duration and covered 2 arctic summers. The scientific work was in charge of Dr. N. A. Mackintosh with Mr. H. F. P. Herdman as Chief Hydrologist and Lieutenant A. L. Nelson, R.N.R. in executive command.

The ship left Thames on October 21st, 1933, and 5 weeks later (Nov. 21st) was on the whaling grounds of South Georgia. After a few days' stop there, she left Georgia and a line of stations was then made across the Scotia sea to the South Shetlands and from there due north to the western opening of the Straits of Magellan. A number of observations was made with the primary object of following the seasonal changes in the water movements and so trace the circulation of the marine animals and plants, on which the whales and all other antarctic life are ultimately dependent. Thirty full stations were made during the cruise and in addition 19 subsidiary "towing" stations. A full station takes 3 to 4 hours; it includes a sounding and noting of meteorological data; of chief importance are the observations of sea temperatures taken at, at least 20 points between the surface and the bottom—here from 2½ to 3 miles deep—and of the collection of water for chemical analysis from the same points. Concurrently, a series of hauls are made, both vertically and horizontally with nets of varying mesh; those of the finest—200 meshes to the linear inch—are designed to collect the microscopic vegetation, which constitutes the "pastures" of the ocean, and is as important at sea as on land; those of the medium mesh are for the smaller forms of animal life, including young stages of whale food; and the largest, for the adult whale food, a prawn some 2½ in. in length—the so called "krill" which forms the only food of the rorquals. A "towing" station is confined to using certain of the nets to keep a check on the intervals between stations, as the distribution of animal and plant life is sometimes "patchy".

"*Discovery II*" returned to South Georgia on April 10th and on her way back repeated the series of stations already gone through. The second season was begun under winter conditions and after traversing the East Pacific Sector and making some important observations, was back at South Georgia on January 27th, 1935. On her return journey, she communicated with a whale marker "*William Scoresly*" which was also working towards the same objective as "*Discovery II*". While the latter was exploring the whales' habitat and the life-history of its food supply, "*William Scoresly*" is interested in marking the whales in order to know whence and where they travel, at what speed and in what numbers.

"*Discovery II*" is to leave London again in the course of the next autumn on her fourth and probably final commission.—(*From an article in 'Statesman', June 18th.*)

Research Notes.

Can Quantum-Mechanical Description of Physical Reality be considered Complete?

ON the basis of the uncertainty principle arising from Quantum Mechanics, the philosophical outlook of modern science has been asserted to be one of indeterminism and the principle of causality has been repudiated by such scientists as Bohr, Heisenberg, Weyl, Eddington and Jeans. On the other hand Einstein, Planck, Rutherford and Silberstein are staunch adherents to the view that the principle of causality still rules Physical Science. In view of this divergence of opinion, a paper with the above title by Einstein, Podolsky and Rosen (*Phys. Rev.*, 1935, **47**, 777) requires careful consideration. In this paper the authors observe that any physical theory which attempts to explain the objective world must satisfy two conditions, *viz.*, that it must be true and that the description given by the theory should be complete. They formulate the condition of completeness in the following terms: "Every element of the physical reality must have a counterpart in the physical theory." They define a physical reality by postulating that "if, without in any way disturbing a system, we can predict with certainty (*i.e.*, with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity." This they consider not as a necessary but only a sufficient criterion of reality. Translating this condition into the language of quantum mechanics they show that in the case of particle with a single degree of freedom its momentum satisfies the condition of reality while its co-ordinate of position does not satisfy that condition. There are now two alternatives: (1) either the description of reality given by quantum mechanics is not complete, or (2) when the operators corresponding to two physical quantities do not commute the two quantities cannot have simultaneous reality. The assumption so far has been that the description given by quantum mechanics is complete so that the second alternative was chosen. The authors now show, however, that this assumption leads

to a contradiction when considered along with the criterion of reality, by proving that two physical quantities with non-commuting operators can have reality. Hence they conclude that the description provided by quantum mechanics is not complete, but express their conviction that some other complete theory is *possible*.

T. S. S.

The Nuclear Spins and Magnetic Moments of the Principal Isotopes of Potassium.

IN the *Physical Review*, 1935, **47**, 739, S. Millman reports the result of his experiments in which the spins and magnetic moments of K_{39} and K_{41} were investigated by the method of magnetic deflection of molecular beams developed by Breit and Rabi. An analysis of the curves led to the value $I=3/2$ for K_{39} and the value of the separation $\Delta\nu$ of the $^2S_{1/2}$ state was thence calculated to be $0{\cdot}0152 \pm 0{\cdot}0006$ cm.$^{-1}$. This result is interesting because it is only recently that the experimental difficulties involved in the measurement of this small separation have been ingeniously overcome by Jackson and Kuhn (*Proc. Roy. Soc.*, A, 1935, **148**, 335), who also obtain a value $\Delta\nu=0{\cdot}0152$ cm.$^{-1}$ They observed the absorption due to a molecular beam moving perpendicular to the direction of observation so that the Doppler broadening was prevented and were thus able to resolve the line. They were unable, however. to fix the value of the nuclear spin definitely, but the work of Millman solves the problem without ambiguity and the magnetic moment of the K_{39} nucleus is then calculated to be $0{\cdot}39$ nuclear magnetons. In the case of K_{41}, it is only concluded that $I > \frac{1}{2}$ and that the ratio of the magnetic moments of K_{41} and K_{39} is such that

$$0{\cdot}42 < \frac{\mu_{K41}}{\mu_{K39}} < 0{\cdot}88.$$

T. S. S.

The Structure of Hydrogen Peroxide.

ON the basis of the value for the dipole moment of the molecule, Theilacker [*Zeit. Physikal Chem.*, (B) 1933, **20**, 142] suggested that in hydrogen peroxide there is a free notation of the two OH groups about the O—O bond as the axis. Penney and Sutherland (*J. Chem. Physics*, 1934, **2**, 492) however concluded from wave-mechanical considerations that the two OH groups are not in free rotation, but fixed at an azimuth of 90°. This structure will also agree with the observed moment value. A. Simon and F. Fehér (*Zeit. Electrochem.*, 1935, **41**, 2291) have now studied the Raman spectrum of 99·5 per cent. hydrogen peroxide and find strong evidence for the structure proposed by Penney and Sutherland. Besides a strong line at 877 cm.$^{-1}$(15) due to O—O oscillation, there are two bands at 1462-1345 (1) and 3410-3200 (3). The latter is the well-known water band due to O—H oscillations. The band at 1462-1345 is a deformation band correponding to the 1648 band of water, and shows two clear maxima corresponding to the two kinds of closely allied deformation oscillations to be expected from the wave-mechanical structure. The absence of free rotation is supported by the fact that there is no doubling of the frequencies O—O and O—H.

The Interaction of Atoms and Molecules with Solid Surfaces.

THE activity of atoms and molecules on solid surfaces is an important problem connected with chemical reactions taking place on solid surfaces. The atoms and molecules may vibrate about a mean position or may migrate from one part of the surface to the other, or may be ejected from the surface altogether, by the thermal agitation of the solid surface beneath them. The problem has been investigated by J. E. Lennard-Jones and C. Strachan [*Proc. Roy. Soc.*, (A), Vol. 150, p. 442] who have worked out formulæ for the mean interval between successive excitations from the lowest vibrational state to higher states and also for the mean time during which the atom remains in an excited state. In the following paper, C. Strachan has examined the process of evaporation of absorbed atoms or molecules on a surface.

A Relation between Molecular Spectra and Constituent Electrons.

H. DESLANDRES has traced a very interesting relation between the vibration spectrum of a molecule and its constituent electrons by means of an empirical formula. The formula is given by $\nu=qd_1/r's'$, where ν is the frequency of vibration in wave-numbers, d_1 is an universal constant having the value $1062{\cdot}5$, s' is the number of electrons in the outer ring or rings of the constituent atoms of the molecule, q is an integer and r' is

another integer usually small. His papers in the *Comptes Rendus* (Paris, 1934-35) contain many experimental proofs of his formula.

Adsorption and Catalysis.

THE mechanism of the adsorption of reacting molecules on a surface in relation to catalytic activity is of considerable interest and has been tackled by a number of workers. It is well known that contact catalysis proceeds from strong adsorption which in turn is due to ionisation of atoms or molecules caused by the surface. A hot filament of Tungsten, Iron, Molybdenum or Platinum placed in vapours of Potassium captures the valence electrons and adsorbs the Potassium ions so formed. Nyrop has developed recently (*J. Phy. Chem.*, 1935, **39**, 643) the ionisation mechanism for the catalytic activity of surfaces. He has formulated two postulates for the same: (*a*) The catalytic surface is at the temperature in question, able to ionise such of the molecules among the reactants as are most difficult to ionise; and the surface will cause a strong adsorption, as the ions formed are attracted by the surface. (*b*) Other conditions remaining the same, a molecule with a lower ionisation potential is adsorbed in preference to one with a higher ionisation potential. The ability to cause ionisation can be represented by an electric field at the surface, the potential barrier hindering the free electrons of the metal from escaping. The energies of activation for the adsorption of a given molecule on surfaces will determine the relative catalytic efficiencies of the different substances. The type of ionic adsorption pictured by Nyrop does not involve assumptions regarding "Peaks" on surfaces, formulated by Taylor. When ionic adsorption takes place, the positive ions formed by ionisation weakens the field due to the surface electrons. Catalytic poisons would, according to this theory, consist of those substances whose ionisation potential is low. Catalysts with high ionising power are more easily poisoned than others with lower ionising power. A too narrow potential barrier in relation to the dimensions of the adsorbed molecule may weaken the power of ionisation. When molecules coming into contact with the surface are highly unsaturated, they are adsorbed at two or more points. The preferential adsorption of highly unsaturated molecules is the cause of preferential hydrogenation of unsaturated organic compounds. The above theory developed by Nyrop may be of use in the elucidation of the numerous problems that arise in contact catalysis.

M. P. V.

The "Transition State" Concept in the Interpretation of Reaction Velocities.

ACCORDING to the kinetic theory chemical reactions ought to proceed at extremely high speed, if every collision between the reactants is effective in bringing about a chemical change. The occurrence of numerous chemical reactions which proceed at measurable rates can only be explained by postulating an energy barrier between the initial and final states. The condition of the reacting system at the top of the barrier is designated the transition state. It is well known that the *energy* of the transition state for any reaction can be calculated from the temperature coefficient of the velocity constant. Similarly it should be possible to estimate the *density* of the transition state from the pressure dependence of the specific reaction rate. M. G. Evans and M. Polanyi (*Trans. Far. Soc.*, 1935, **169**, 877) have outlined a general theoretical treatment of the reaction velocities by the transition state method and have applied it to interpret the variations in velocity constants of reactions at high pressures. They are thereby able to account for the exponential dependence of reaction velocity on pressure. They also explain the strong acceleration brought about by pressure in the case of many of the so-called "slow" reactions. It is often surmised that reactions accompanied by a diminution in volume should be accelerated by pressure. The theory detailed in this paper, however, shows that this can only be true if the density of the transition state is intermediate between that of the initial and the final states. The *cis-trans* isomerisation of fumaric acid is not accelerated by pressure though the reaction is accompanied by a diminution in volume. The transition state appears in this case to be one having a lower density than either the initial or the final state. The ideas set forth in this paper, besides their theoretical interest, seem to be of value in the investigation of high pressure reactions of technological importance.

K. S. G. D.

Effect of Cathode Rays on Hydrophobic Sols.

THE literature on the effect of ionizing radiations on colloids is one of conflicting results due to large effects of impurities, sensitiveness to hydrogen-ion concentration and other unknown factors such as internal photo-electric action. May Annets (*J. Phys. Chem.*, 1935, **509**, 39) has investigated the effect of cathode rays on sols of copper, gold, silver, lead, bismuth, platinum, ferric hydroxide and arsenious sulphide. The stability of both positively and negatively charged sols is found to decrease. This is to be expected; the cathode rays on collision with the sols give up their kinetic energy and their charge. With the gain of the charge the stability of the sol will increase or decrease as the sol is negatively or positively charged. The kinetic energy produces ionisation of the dispersion medium and thereby the increase of electrolytic concentration, which in general decreases sol stability irrespective of the sign of the charge. In the absence of a permanent chemical reaction the positive and negative ions recombine with production of heat.

Under cathode ray bombardment the rate of heating of the sol was found to be definitely greater than the rate of heating of water, a phenomenon which is yet to receive an adequate explanation. The accepted heats of flocculation, the energy due to the charge on the surface of the colloid particles and the energy due to the compression of the water around the colloid particles being too small by 10^3, 10^6, 10^{13} times respectively, to account for the observed difference, it is not clear what additional source of energy in the colloid state could account for this phenomenon.

K. S. R.

Starches from Old and New Rice.

THE difference in the physical properties and in the behaviour under various treatments of starch from old and new rice forms the subject of a study by D. L. Sahasrabuddhe and M. M. Kibe and is reported in the *Indian Journal of Agricultural Science*, Vol. V, Part I. Coarse rices, reported to be fit only for bread making as distinguished from the finer ones fit for use as boiled rice, are composed of larger grains, but all are alike in general appearance with the usual characteristic polygonal shape. In one and the same variety, old and new grains show no difference in size. In their behaviour towards methylene blue and iodine, no difference in the starch of different varieties or of different ages was noticeable. Older rices and those of the finer cooking varieties soften more than do new rices and those of the coarser bread varieties, when treated with boiling water and with dilute caustic soda. Likewise as an indication of the extent of digestibility, it is brought out that the hydrolysing action of hydrochloric acid, diastase and pancreatin was more on old rices than on new rices, the same behaviour differentiating also the finer rices from the coarser ones, except in regard to pancreatin. The rices also show significant difference in the amount of liquefaction of the starches on boiling with water, the older liquefying much more than the newer ones and hence being more readily digested. The presence of an amylo-hydrolytic enzyme in the rice grain is established, the prolonged action of which on rice in storage may account for the greater susceptibility of older rices to the various treatments described.

A. K. Y.

Treatment of Opium Habit with Lecithin.

A VERY important contribution towards treatment of opium addiction has been made by Wen-chao-Ma and co-workers at the suggestion of Dr. J. Heng Liu, Chairman of the National Opium Suppression Commission, China. (*F. E. A. T. M.*, Nanking, 1934, Vol. II, 381–387.)

The authors observed that opium smokers can secure comfortable and spontaneous cure by means of lecithin diet. A daily dose of 60–90 gm. of lecithin from Soya bean took from 3 to 6 weeks and sometimes more to break the habit. Soya bean lecithin was found to have advantage over egg yolk preparation in that it is less expensive and is said to be more easily assimilated.

Lecithin does not have the property of directly suppressing the symptom. It has been observed that in serious cases of opium addiction, the amount of lipoid material in the body cell is reduced to nil, while in moderate cases there exists a fair amount and in light cases a relatively big amount. When lecithin is administered orally, the lipoid material is gradually increased with the external manifestation of corresponding subsidence of the craving symptom and an amelioration of the opium habit. The patients treated with lecithin diet had no

disturbance in bowel movement, their appetite was good and they increased in body weight. They enjoyed a sound sleep and felt happy throughout the treatment.

According to the authors, lecithin treatment affords a means of suppressing opium habit without the use of military force or elaborate hospital equipment.

N. C. D.

Transmissibility of Tobacco Mosaic Virus by Aphids.

IT being fairly well established that heavy infections with tobacco mosaic in tobacco fields are not attributable to the dissemination of the virus by aphids from tobacco to tobacco, the possibility of transmission by aphid agency of the virus from other host plants is investigated by Isme A. Hoggan (*J. of Agr. Research*, Vol. 49, No. 12). Out of the eighteen hosts tested, transmission was obtained only from the tomato, occasional infections developed in eight and no infection at all from the others. The positive results were however rather insignificant, as only one aphid out of 129 caused infection even in the best of the three species of aphids used as carriers. It is concluded that it is unlikely that any appreciable amount of dissemination of tobacco mosaic is brought about by aphids, except perhaps from the tomato.

The Relation of Plant Characters to Yield in Sorghum.

CORRELATION studies of eight different plant characters as related to yield of grain per plant in respect of two irrigated and three rain-fed varieties of sorghum, carried out over a series of two seasons in Coimbatore by G. N. Rangaswamy Ayyangar and his assistants, bring out certain characters as reliable indices in selecting for high yield (*The Indian Journal of Agricultural Science*, Vol. V, Part I). The diameter of peduncle, weight, length and thickness of earhead and straw weight have given high positive correlation values. The weight of 100 grains has given high correlation values in the case of the irrigated varieties and low values in the case of the rain-fed varieties. The length of peduncle is either not correlated or is negatively correlated with yield. In the two irrigated varieties, the duration of the crop was also studied and was found to be negatively correlated with yield. A review of the previous work on the subject both in India and outside is also given, the conclusions of the authors being in general agreement with those of the workers in Bombay for all the characters common to both the studies.

A. K. Y.

A Further Note on the Feeding Mechanism of *Chirocephalus diaphanus*.

H. G. CANNON in the above paper (*Proc. Roy. Soc. Lond.*, B, 1935, **806**, 455) describes the feeding mechanism of *Chirocephalus* and largely agrees with the description given for *Anostraca* by Eriksson (*Zool. Bidr. Uppsala*, 1934, Vol. 15, p. 23). There are, however, two important points in which Cannon differs from the latter author and they are (1) the method of production of the oral food current, and (2) the function of the labral gland. According to Eriksson, the current is a continuous stream while Cannon maintains that it is an intermittent one. As regards the labral gland, Eriksson believes that the secretion of the gland agglutinates the extra food matter to be thrown away, while Cannon is of opinion that the glandular secretion is helpful in aiding *Chirocephalus* in binding the food to be eaten. Moreover, the author has been able to show by suitable staining, the existence of an anteriorly-directed food current. With regard to the labral gland secretion he notes that "a part of it oozes round the sides of the labrum and forms a mass underneath the head region and mouth, while a part of the secretion passes backwards beyond the tip of the labrum where it is sucked against the inner surface of the anterior trunk limbs." Here it converts the anteriorly-directed food current into a groove.

Origin and Nature of Nucleolus.

MARY S. GARDINER (*Quart. J. Micro. Sci.*, 1935, **77**, 308) has examined the structure and behaviour of the nucleolus in a number of plants and animals. Using Feulgen's technique, the author has come to the conclusion that the nucleolus is not chromatinic and that it is albuminoid in chemical composition, probably closely allied to "formed yolk". Its significance in regard to secretory activity of the cell is considerable and is by no means an accumulation of waste matter. Its absence in cells where there is

no secretory activity like the oogonia and spermatogonia and spermatocytes of *Limulus* and *Tenebrio* points to a definite correlation between the nucleolus and secretory activity of the cell. And the transformation it undergoes during the process of vitellogenesis when it becomes vacuolated and finally disappears also points to the same conclusion. Cells of most plant tissues are to be considered secretory and the universal presence of a nucleolus in these cells emphasises this idea.

The Autonomic Nervous System of *Amphioxus*.

PROF. J. BOEK'S paper (*Quart. J. Micro. Sci.*, 1935, **77**, 308) describes the enteric nervous system of *Amphioxus lanceolatus*. *Amphioxus* has been often denied a sympathetic nervous system comparable with that of higher vertebrates. The author has, however, found in the walls of the intestine a nerve plexus comparable with the plexus of Auerbach of higher vertebrates and a more delicate nerve plexus analogous to that of Meissner is also reported. The ganglion cells and their synaptic connections with pre- and post-ganglionic nerve fibres all recall the sympathetic system of higher vertebrates. The entire plexus is connected with the central nervous system by visceral nerves and dorsal roots.

Relations of Anorthosite to Granite.

IN connection with the sixteenth International Geological Congress, a very instructive excursion was conducted to the well-known anorthosite areas of Adirondacks and Duluth. A comparison of the rock types from the above areas has been made by F. F. Grout and W. W. Langley (*Journal of Geology*, Vol. XLIII, No. 2). The difference between the two is due to the intense deformation of the Adirondack rocks, during or after crystallisation developing granulation and showing minerals and structures characteristic of metamorphic rocks. At Duluth the rocks have suffered little or no deformation and therefore in common with other anorthosite areas, the granitic phase of the magma seems to have evolved from gabbro magma sometime after the anorthosite was formed. After a very careful study of these rocks both in the field and in the laboratory they have suggested that both the granite and the anorthosite are related to gabbro, but not differentiated directly from each other.

The Vitamin A Content of Certain Sweet Potato Varieties.

VERY marked differences in the Vitamin A content of different varieties of the sweet potato (*Ipomœa batatas*) are disclosed as the result of a study of five varieties commonly grown in Tennessee (*J. of Agr. Research*, Vol. 50, No. 2) by F. L. MacLeod and his students. The differences were of the following order, *viz.*, 13,500 units, 900 units, 1,800 units, 9,000 units and 4,500 units per pound respectively by the varieties Nancy, Hall, Triumph, Southern Queen, Porto Rico and Yellow Jersey. It is also brought out that the Vitamin A content materially increases by the storage of the potatoes for two months or more, the Porto Rico increasing from 9,000 to 29,000 units and the Yellow Jersey from 4,500 to 18,000 units by this process. The observation made in previous work that the Vitamin A content increases with the depth of pigmentation of the varieties is also confirmed.

A. K. Y.

Crystalline Insulin.

BY their new method of crystallisation of insulin hydrochloride from buffer solution, Scott and Fisher (*Biochem. J.* 1935, **29**, 1048) have shown that different samples of insulin hydrochloride having an ash content of 0·02 per cent., crystallised from an ammonium acetate buffer solution by means of zinc, cobalt or cadmium, showed constant values for the respective metals. The average ash content of each insulin salt was proportional to the atomic weight of the metal, and these facts indicate that crystalline insulin contains the metals as chemically combined constituents and not as impurities.

Science Notes.

Two Charophytes from Kolhapur (S. M. C.).—Mr. S. A. Parandekar, Rajaram College, Kolhapur, writes :—Among the flora of Kolhapur two species of Chara have been recently observed and identified as *Chara brachypus*. A. Br. and *Chara corallina* with the help of the key published by Allen (Charophyte Notes from Gonda, U.P., *J. Bombay Nat. Hist. Soc.*, **30**, 589). The Charophytes from Kolhapur have not been so far recorded and studied, although about twenty species have been reported from Deccan. The report of the occurrence of the two charophytes might therefore prove of interest.

Chara brachypus A. Br. has been already reported from Bombay (Salsette island) by Dixit (*J. Ind. Bot. Soc.*. 10, 205) and by Allen from Gonda, U.P.

Chara corallina (which is not so abundant here as the other species) has been also recorded from Gonda by Allen, but not by Dixit from Bombay.

I am thankful to Mr. G. O. Allen, and Prof. S. C. Dixit, who have worked on Indian Charophyta, for informing me that Charophytes from Kolhapur have not been so far reported.

* * *

Awards of Silver Jubilee Medals.—We have great pleasure in felicitating scientists of India who have been decorated with Silver Jubilee Medals on the occasion of the recent Jubilee Celebration of H. M. the King-Emperor. The list given below is, however, incomplete.

Dr. P. K. Acharya, M.A., Ph.D., D.Litt.; S. P. Agharkar, Esq., M.A., Ph.D., F.L.S.; Rai Sahib Arthaballah Mahant; S. N. Bal, Esq., M.Sc., Ph.D.; Dr. Baini Prashad, D.Sc., F.R.S.E., F.L.S., etc.; D. V. Bal, Esq., L.Ag. (Hons.), A.I.C., F.C.S.; A. C. Banerji, Esq., M.A. (Cantab.), M.Sc.; S. B. Belekar, Esq., M.Sc.; D. Bhattacharji, Esq.; C. C. Calder, Esq., B.Sc., B.Sc. (Agric.), F.L.S.; H. Crookshank, Esq., B.A., B.A.I. (Dub.); J. F. Dastur, Esq., M.Sc., I.A.S.; M. L. De, Esq., M.A., I.E.S.; Deoras, Esq., M.Sc.; Dr. H. B. Dunnicliff, M.A., D.Sc., F.I.C.; Sir L. L. Fermor, O.B.E., A.R.S.M., D.Sc., F.R.S., etc.; Dr. C. S. Fox, D.Sc. (Birm.), M.I.Min.E., F.G.S., etc.; Babu S. K. Ganguli; Rao Sahib S. N. Godbole, M.Sc.; Dr. F. H. Gravely, D.Sc.; Dr. A. M. Heron, D.Sc. (Edin.), F.G.S., F.R.G.S., etc.; Dr. S. L. Hora, D.Sc., F.R.S.E., etc.; Jamaluddin, Esq.; Gurudatta Karwal, Esq.; R. P. Khosla, Esq.; Dr. K. Krishnamurthi, D.Sc.; D. N. Mehta, Esq., B.A. (Oxon.); Dr. E. P. Metcalfe, D.Sc., F.Inst.P.; M. A. Moghe, Esq., M.Sc.; Dr. A. L. Narayan, D.Sc., F.Inst.P.; Dr. B. K. Narayana Rao, B.A., M.B.C.M., M.R.C.S., D.P.H., D.O.; M. Owen, Esq., M.Sc., F.I.P., I.E.S.; G. R. Paranjpe, Esq.; M. W. Sayer, Esq., B.A., Dip. Agri. (Cantab.); D. R. Sethi, Esq., M.A., B.Sc.; Dr. F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S.; Dr. B. K. Singh, M.A. (Cantab.), D.Sc., F.I.C.; Rao Bahadur B. Viswanath, F.I.C.; D. N. Wadia, Esq., M.A., B.Sc., F.G.S., etc.; Dr. T. S. Wheeler, Ph.D., F.I.C., F.Inst.P., M. I.Chem.E.

* * *

Origin, Scope and the Present Position of Potato Research at the Agricultural Research Station, Nanjanad.—The potato was introduced into the Nilgiris in the beginning of the nineteenth century. As the climate was quite suitable for its cultivation, it gradually extended and the local ryots (Badagas) finding the crop most remunerative took to its cultivation readily.

The crop now occupies nearly 11,000 acres. The potato is a very delicate crop and the ryots out of ignorance handled the crop carelessly and consequently deterioration set in rapidly.

As the crop is of very appreciable economic importance in the Nilgiris where it forms the main crop raised by the indigenous hill population and as its cultivation was threatened to extinction, the Government of Madras opened a Station in 1917 for the improvement of potatoes and supply of good seeds to the potato growers on the Nilgiris.

The Station is situated in the Nanjanad village and is 10¼ miles from Ootacamund on the Governer Shola Road. The soil in the Station is a poor clayey loam and is typical of that to be found on the Nilgiris. It is all dry land. The Station is exposed to the South-West monsoon, the violent winds of which usually damage the potato haulms. The area of the Station is 161 acres and that under cultivation is nearly 45 acres.

The chief crop is potato, but korali and samai are grown in rotation and lupin, a leguminous crop, is grown as a green manure crop. Two crops of potatoes are grown annually the first being planted in March-April and harvested in August-September and the second sown in August-September and harvested in December-January. The bulk of the area is planted to first or main crop in the month of March-April.

Up to 1933, the work on potatoes was carried on in a restricted scale and was confined to the testing of improved varieties of potatoes, method of cultivation and manuring for the purpose.

The Government of Madras approached the Imperial Council of Agricultural Research for a grant for expansion of research work on potatoes chiefly with the object of breeding new varieties. The Imperial Council of Agricultural Research accepted the scheme and sanctioned a grant of Rs. 19,995 spread over a period of 5 years for research work on potatoes.

The work commenced from June 1933. A detailed study of the Botanical characters of all the varieties grown at this Station was made and a list of varieties that produce and retain flowers and those that bear visible pollen have been worked out.

Inter-varietal crosses have been carried out successfully and as many as 7 crosses have been obtained. The seedlings have been raised and are awaiting further study and selection of suitable types for cultivation. It is hoped that some of them may prove better than the existing varieties and a few may be fit for cultivation in the plains as well.

* * *

Combing of Good Quality Indian Cottons.—The Publicity Officer, Indian Central Cotton Committee, writes :—There is enough evidence to show that the present-day tendency in the cotton textile industry lies in the increased production of yarns of finer counts. This can be achieved either by using superior quality cottons or by subjecting cotton of a given quality to some such mechanical treatment as will appreciably raise its spinning performance.

Among the latter the most effective method now available is that known as combing. This method consists essentially in the extraction by the combing machine, of a known percentage of the relatively short fibres which are to be found to a greater or less extent in all cottons. The combing process besides serves to parallelise the fibres which results in a greater regularity and higher strength of the yarns. It also serves to reduce such undesirable features as neps from a cotton.

Hitherto the combing process has been almost exclusively restricted to the long staple non-Indian cottons. This restriction is presumably based on the assumption that combing, with its consequent rejection of a large percentage (generally from 15 to 25 per cent.) of the fibres, is economically suitable for such cottons only. In order to examine the limiting performance, as a result of combing, of Indian cottons and to test, among other things, the validity of this assumption, a series of experiments were carried out at the Indian Central Cotton Committee's Technological Laboratory, Bombay. Four Indian cottons of good quality were selected for these experiments. Each cotton was combed to the extent of 20 per cent. and 30 per cent. and spun into appropriate counts of yarn on a ring frame using the ordinary and a high draft system of spinning. The comber wastes extracted from these cottons were respectively mixed with four Indian cottons of suitably low quality, and the mixtures were spun into carded yarns of appropriate counts.

These tests form the subject of a Technological Bulletin (Series A, No. 27) of the Indian Central Cotton Committee. The bulletin comprises five sections and a comprehensive appendix and contains such items of practical interest as a description of the cottons and the machinery used in these tests and full details of treatment accorded to each sample. The results obtained are suitably tabulated and include particulars of fibre-properties, yarn test results, waste percentages, yarn breakages during spinning, and the strength, evenness and neppiness of the yarns spun from the various samples.

The joint authors, Mr. R. P. Richardson, F.T.I., and Dr. Nazir Ahmad, M.Sc., Ph.D., F.Inst.P., discuss the implications of the various results at some length and they offer the chief conclusions drawn from them in the form of a summary.

The work embodied in this bulletin is a valuable contribution to the subject of cotton combing and in its 31 pages will be found much data, of a specific character, which will be of great value to the practical spinner. The bulletin is available to the public at a nominal cost of Re. 1.

* * *

The Mysore Veterinary Medical Association, Bangalore.—The seventh annual conference of the Association was held on 22nd, 23rd and 24th June 1935. Sir K. P. Puttanna Chetty in opening the Conference eulogised the part played by the Veterinarian in the rural economy of the country and stressed on the point that control over the supply of wholesome milk and meat should be handed over to the Veterinary authorities. He hoped that every taluk in the State would soon be provided with a Veterinary dispensary. In referring to Veterinary Research he pointed out the importance of co-operation between the Medical Department and the Veterinary Department as both the Sciences were inter-dependent in matters of experiments on animals and their applicability to human beings. He also referred to the progress shown in the production and preparation of sera and vaccines at the Mysore Serum Institute, which are largely and effectively used both in and outside the State.

Mr. K. Krishnaiengar, Superintendent, Mysore Civil Veterinary Department, welcoming the delegates to the Conference pointed out that the members of the Veterinary profession in Mysore had succeeded in reducing the incidence of cattle disease to the lowest possible minimum by promptly adopting measures of control. He impressed on the members the need for further educating the private owners as well as the public bodies in the hygienic maintenance of live-stock. He further observed that no one was better qualified than the Veterinarian to be in charge of Inspection of milk and meat which are two of the most important foods of human beings. He deplored the apathy of the local bodies on this question as they do not seem to have yet realised the importance of such work.

Major R. W. Simpson in his inaugural address hoped that before long the Veterinary Department would be made an independent unit. Apart from his capacity to treat the sick animals and prevent the spread of contagious diseases the Veterinarian is well qualified to inspect animal food products, to certify for their wholesomeness and purity and thus prevent diseased meat and milk being sold. The Veterinary Surgeon in western countries plays an important rôle in matters relating to public health. He also referred to the live-stock trade which is one of the chief trades in Mysore amounting to a crore of rupees every year and made mention of the good work that is being turned out in the Cattle Breeding Station at Ajjampur, in the matter of improvement of live-stock. He next referred to Poultry Farming and congratulated the Government of Mysore on sanctioning funds for the purpose at Dodballapur and suggested that the breeding of poultry should be taken up in right earnest as it is indeed a profitable and useful concern.

Two resolutions were passed, one for the supply by the Government, of good breeding bulls and buffaloes to village panchayats to improve the breed of the cattle in those parts and the other for awarding a gold medal every year to the member who is adjudged to have done original scientific work.

On the second day twelve papers were read – Important among which were (1) "Local Anæsthesia with Planocaine", (2) "Variola in domestic animals, with special reference to Sheep-pox" and (3) "The Veterinarian's rôle in public health".

The members of the Association visited the Mysore Serum Institute on the 3rd day of the sessions where lectures and demonstrations were held on "The recent advances in the preparation of biological products" and "Epidural Anæsthesia" in animals. In the afternoon the representatives of the General Electric Company demonstrated the uses of the portable "X-Ray" set in animal practice.

The session came to a close after the departmental conference at which important matters

pertaining to the working of the Civil Veterinary Department in Mysore, were discussed.

* * *

Lady Tata Memorial Trust.—The Trustees of the Lady Tata Memorial Trust have announced the following Indian Scholarships for the year 1935-36, each of the value of Rs. 150 per month, for scientific investigations having a bearing on the alleviation of human suffering, on the occasion of the fourth anniversary of the death of Lady Tata.

(1) Mr. N. C. Datta, M.Sc., to study the rôle of nutrition and the effect on the body, of mineral contamination of foodstuffs during cooking and storage. (2) Mr. K. N. Gaind, M.Sc., to synthesise new compounds possessing local anæsthetic properties. (3) Mr. M. C. Nath, M.Sc., to carry out chemical and biological analyses of proteins of Indian foodstuffs. (4) Mr. Y. V. Sreenivasa Rau, M.Sc., A.I.I.Sc., to study the proteins of Indian foodstuffs, chemical and biological analyses (at Halle, Germany). (5) Mr. R. Chakrabothy, M.Sc., to investigate nutritional problems of Indian foodstuffs with special reference to Vitamin C. (6) Mr. N. B. Das, B.Sc., for work on the Oxytocic harmone and on oxidation-reduction systems in the body (at Stockholm). (7) Mr. T. N. Ghosh, M.Sc., A.I.I.Sc., for research on the preparation of new anti-malarials. (8) Mr. H. S. Mahal, M.Sc., to work on the anthelmintics, synthesis of substances and examination of Indian plants having anthelmintic properties. (9) Dr. B. K. Nandi, M.Sc., Ph.D., A.I.C., to work on the synthesis of anti-malarials on the line of plasmochin and atebrin types (at Oxford). (10) Mr. H. B. Sreerangachar, M.Sc., A.I.I.Sc., to investigate the growth-promoting and anti-anæmic properties of liver.

The trustees have also made eight international awards for research in diseases of the blood with special reference to leucæmias.

* * *

Pramatha Nath Bose Memorial Medal.—The Council of the Asiatic Society of Bengal has adopted the following regulations regarding the award of the medal:—(1) The Medal shall be awarded every three years at the Ordinary Annual Meeting of the Asiatic Society of Bengal in February. (2) The Medal shall be bestowed on a person, who, in the opinion of the Council, has made conspicuously important contributions to practical or theoretical Geology with special reference to Asia. (3) The General Secretary shall, at a meeting of the Council preceding the Ordinary Meeting in November, place before the meeting the names of at least three Geological experts and three members of the Society for consideration. The Council shall then proceed to appoint an Advisory Board of not less than three members selected from the list placed before them provided that the Council, for special reasons, shall be entitled to select persons outside the list. The Advisory Board shall always include two Geological experts and the General Secretary shall be an *ex-officio* member of the Board. (4) The Advisory Board shall be termed "The Pramatha Nath Bose Memorial Medal Advisory Board." The Board shall appoint a Chairman from amongst its members who shall have a casting vote (in addition to his own vote) in the event of the number of votes being equally divided. (5) The General Secretary shall call a meeting of the Advisory Board on the first convenient date subsequent to the first Monday of December, at the same time requesting members to bring with them to the meeting a detailed statement of the work or attainments of such candidates as they may wish to propose. The General Secretary shall also place before the Board for consideration detailed statements of the work or attainments of any other candidate submitted by any Fellow of the Society. The Board shall make such arrangements as may be necessary for the selection of a name to be submitted to the Council at their December meeting. (6) Notwithstanding anything determined in these Regulations, it shall be within the competence of the Board to abstain from the selection of any name to be submitted for the year and to report accordingly to the Council, in which case, provided the Council concurs, the award for the year shall lapse and shall be postponed to the next following year to be determined in the manner prescribed in the above rules, and, if necessary, deferred again year by year, until an award be made, the period mentioned in Rule 1 in such case to be reckoned from the date of the award.

* * *

The University of Madras has conferred the degree of Doctor of Science (D.Sc.) on (1) Mr. A. V. Varadaraja Iyengar, M.Sc., (2) Mr. P. P. Pillai, M.Sc., (3) Mr. C. Sambasiva Rao, M.Sc., and (4) Mr. C. P. Gnanamuthu, M.A. Mr. V. Krishnan, M.A., has received the degree of Doctor of Philosophy (Ph.D.).

* * *

Two Inscriptions from Barakar.—At the ordinary meeting of the Asiatic Society of Bengal, held on the 1st July, Dr. S. N. Chakravarthy read a paper on the two inscriptions which are found on the "right door-jamb of the Ganesha temple in the Begunia group of four temples at Barakar in the Burdwan District". He discussed the previous literature referring to the date of the inscriptions and believes that on palæographical grounds, Saka 1468 or 1498 should be preferred. The Palæographical evidence was discussed at length and the transcription and translation of the inscription were also given.

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It has been proposed to present Rajasevasaktha Rao Bahadur S. Krishnaswamy Iyengar, M.A., Ph.D., F.A.S.B., formerly Professor of Indian History and Archæology, University of Madras, with a commemoration volume of papers contributed by scholars both in India and abroad, engaged in the field of Indian Historical and Archæological learning and research, on the occasion of his sixty-fifth birthday (15th April 1936). An appeal signed by S. Radhakrishnan, Dr. Surendranath Sen, Dr. P. K. Acharya, Dr. Radha Kumud Mukherjee and a number of others has been issued, calling for donations towards the cost of printing the volume. All communications may be addressed to Mr. C. S. Srinivasachari, M.A., Professor of History, Annamalai University, Annamalainagar, or to Professor V. Rangacharya, M.A., L.T., "Sri Rangadaman," Lloyds Lane, Royapettah, Madras.

* * *

Rao Bahadur K. V. Rangaswamy Iyengar has been appointed Principal of the College of the Benares Hindu University.

Rt. Hon'ble V. S. Sreenivasa Sastri has been appointed Vice-Chancellor of the Annamalai University.

* * *

Rao Bahadur T. S. Venkataraman will represent India at the World Sugar Conference to be held at Brisbane, Queensland, in the last week of August.

It is understood that Dr. (Miss) E. K. Janaki Ammal will attend the Botanical Conference to be held at about the same time in Cambridge.

Dr. Issac, Second Imperial Entomologist, Pusa, will attend the Imperial Entomological Conference in London, after which he will visit the United States, Porto Rico and Hawaii Islands with a view to study the methods of Pest Control in regard to Sugarcane. The problem has acquired importance and urgency in view of the fact that considerable damage is being caused to sugarcane in United Provinces, due to insect pests.

* * *

Sir S. Radhakrishnan left India for Geneva to attend the forthcoming meeting of the International Committee of Intellectual Co-operation on 15th July. The meeting is expected to last for a week. Sir S. Radhakrishnan will visit Oxford, and is expected to return to India in August.

* * *

It is understood that Dr. C. P. Turner, Ph.D., Chairman of the Institute of Technology, Cambridge, Mass. (U.S.A.) has been appointed by the Calcutta University to deliver a course of six lectures on the following subjects relating to "Organisation of Health Education":—underlying principles in health education; construction of curriculum in health education; and school practices of health education.

* * *

Principal P. Seshadri, Rao Bahadur Thakur Chain Singh, Educational Minister, Jodhpur State, Principal A. A. C. Harvey and Principal F. G. Pearce, will constitute the delegation to the World Conference on Education. The Conference will be held at Oxford from August 10th to 17th and Principal P. Seshadri will lead the delegation.

* * *

Professor Brauner, prominent Czecoslovakian chemist, died in February at the age of 80. He was well known for his researches on the periodic system of elements. He was a pupil of Bunsen and Rowe, and by collaborating with Ramsay, Richards, Baxter, Dixon and Mendeleeff, he became a prominent figure in inorganic and analytical chemistry. It was due to him that oxygen was adopted as the basic element in calculating atomic weights. His researches were mainly confined to the rare elements and as a result of his work, beryllium was placed in the second group of the periodic table.

* * *

According to an *Associated Press* message the Government of Travancore are contemplating the starting of a factory for refining china clay and manufacturing porcelain at Kundara, near Quilon. The deposits of china clay at Kumbalom have been found to be of the standard quality. The deposits cover an area of over 30 square miles. It is reported that cheap skilled labour is also available.

* * *

From a report appearing in the *Hindu*, it is understood that proposals are submitted to the Government of Travancore for establishing a separate Fisheries Department instead of its being attached to the Agricultural Department as at present. Canning and cold storage are to be introduced; it is suggested that deep sea fishing should be started and the fish canning should be improved on scientific lines.

The Department now maintains four fishery schools where fisher boys and girls are given elementary schooling and the special fishery school at Karungapalli is making steady progress. Improvement and expansion of the schools, and the establishment of a library, museum and laboratory are also under contemplation.

The State has a fishing population of one and a half lakhs. 95 per cent. of the population eat fish and the foreign trade in fish amounts to 40 lakhs, and a maritime state like Travancore affords an almost untapped source of wealth in fisheries.

* * *

Manurial Research in Travancore.—Among the important manurial experiments which are in progress in the State, mention may be made of (1) the effect of phosphatic, nitrogenous and general manures on paddy cultivation in South Travancore. Superphosphates have given the highest yield; (2) comparison of the values of artificial manures and green manures on paddy; and (3) improvement of alkali soils by the application of special green manures.

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The research work done in India on sugarcane both in its agricultural and manufacturing side since 1932, was reviewed at a recent meeting of the Sugar Committee of the Imperial Council of Agricultural Research. The review shows that the progress made has not kept pace with anticipations and that if the present rate was not accelerated India would not be able to stand on her own legs within the period of protection. The paucity of funds for sugar research and the fact that the Central Research Institute had not been started early enough are the two causes responsible for the slow progress.

* * *

The Terminology of Illumination and Vision. H. M. Stationery Office. Price 6*d.* net.—This paper, of which an up-to-date revised edition is now issued, contains definitions and clear explanations of all the common physical, physiological and ophthalmic terms used in the study of the problems of illumination, the understanding of which is essential to all who wish to follow the rapid progress now being made in their solution.

* * *

Research in Tuberculosis.—It is understood that the Italian Fascist National Federation against Tuberculosis has placed six scholarships at the disposal of the International Union against Tuberculosis of Paris at "Carlo Forlaniani" Institute in Rome for the session from November 15, 1935 to July 15, 1936.

These scholarships are intended for foreign medical practitioners who are already familiar

with tuberculosis problems, and who wish to improve their knowledge in this branch of medicine.

* * *

Occupational Diseases.—Certain occupational diseases, *e.g.*, silicosis, arsenic poisoning, pathological manifestation due to radium and other radioactive substances, epitheliomatous cancer of the skin, will, it is understood, be added to the list of diseases now coming under the convention regarding workmen's compensation for occupational diseases. The most important of these is silicosis, which is associated in other countries with gold mining and with many common industrial processes of which sand-blasting, manufacture of china glass and pottery and stone cutting are examples. Silicosis cannot ordinarily be diagnosed definitely except by well-equipped radiological apparatus, and the Government of India according to an *Associated Press* message have started enquiries regarding the availability of facilities for such tests in the various industrial areas.

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Sir Asutosh Mukherjee Memorial Institute.—The Minister of Education, Bengal, performed the opening ceremony of the Memorial Building on June 29th. The building will not only house the Institute but the Asutosh College founded by him at the beginning of the present century. "It would be a meeting place for people of all nationalities, united by a permanent bond of fellowship based on honourable understanding and determination to advance the best interests of the province and the country."

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Royal Institute of Science, Bombay.—Prof. R. H. Dastur, Head of the Botany Department, has gone on deputation as Plant Physiologist under the Indian Central Cotton Committee, Lyallpur (Punjab).

Mr. G. V. Jadhav of the Chemistry Department has sailed for higher studies in the University of Manchester as one of the Sir Mangaldas Nathubhai Scholars of the Bombay University.

As a result of Scientific Exhibition organised by the Institute in December last in aid of Bombay Hospitals a net sum of Rs. 17,500 has been made over to the Hospitals Fund Committee.

The staff and students of the Institute have collected about Rs. 250 in aid of the Quetta Earthquake Relief Fund.

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The aluminium globe in which Professor Piccard and M. Max Cosyns made their second ascent into the stratosphere three years ago was presented to the South Kensington Museum, London. The actual presentation was performed by M. Jean Willems, who was accompanied by the two scientists.

* * *

Sir E. Shackleton's famous ship, the "*Quest*" will leave shortly for the Arctic carrying an expedition which will explore the area of latitude 70° for geographical purposes. The expedition will be led by Mr. F. L. Wager, who will be accompanied by his wife. The second in command is Mr. Court Aulo, who, four years ago, spent the whole of one winter alone in a remote part of Greenland, snowed up in a small hut.

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Microvivarium.—The microvivarium which, according to Dr. Frank Thore, is the "biological analogue of the Planetarium," is a highly useful instrument for clear and effective instruction in biology and therefore constitutes an indispensable complement to laboratories, museums or botanical and zoological gardens. In a paper appearing in the *Educational Screen*, April 1935, Dr. Georg Roemmert has given an account of this device. The microvivarium exhibit attracted a great deal of attention at the Century of Progress. "In the microvivarium the micro-projection method has been used on a large scale for the first time. This method shows essentially the same things as we otherwise perceive in a microscope. The image is produced from the object itself, by the objective of the microscope with all its colours and movements. The difference is simply that in micro-projection the picture, in huge magnification, appears on a screen, and consequently observation on a microscope is rendered superfluous. The great advantage of this method for popular presentations is that explanations can be given once only for all observers and there is no necessity for unpractised layman to manipulate the microscope. Moreover, objective demonstration in the enormously magnified field of vision, over one yard in diameter, leaves behind an unforgettable impression."

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According to a Calcutta message three earthquake shocks, one of considerable intensity were felt at Siliguri, Bengal, on Thursday, the 4th July. No loss of life or damage to property has been reported. Shocks were also felt at Kalipong and Jalpaiguri in the Dinajpur District.

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The second meeting of the Imperial Sericultural Committee will be held at New Delhi on Wednesday, October 30, 1935. The meeting will consider the progress of the schemes, which have been initiated recently with the aid of the grant given by the Government of India for the purpose and will advise on the allotment of funds available for 1936-37. The schemes started in Bengal, Assam, Madras, Bihar and Orissa and Burma are designed mainly to increase the production of disease-free seed. There are also schemes for investigation of questions connected with silkworm disease.

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Announcement :—

Fifth Congress of the International Society of Sugarcane Technologists (Brisbane, Australia, August, 1935).—The International Society of Sugarcane Technologists is to meet at Brisbane in Australia on the 27th August, 1935. This Society, which generally meets once in three years and alternately in the Eastern and Western hemispheres, has already held four sessions, *viz.*, in Hawaii, Cuba, Java and Puerto Rico. The one at Brisbane is to be the Fifth Congress of this body.

Visits to experiment stations and excursions to factories and sugar plantations have been important adjuncts to the meetings of the Congress. While the actual sessions at Brisbane are to last about a week from 27th August, excursions are to occupy a fortnight after the meeting. We learn that leaders of the Sugar Industry in Australia are to deliver addresses at Brisbane so as to give the delegates to the Congress a true perspective of the special conditions obtaining in the Australian Sugar Industry.

One special feature of the industry in Australia is the employment of White labour alone.

The Congress is to consist of eight different sections representing the various aspects of the Sugar Industry. In the manufacturing section a special feature will be "Sugar boiling with particular reference to the refining quality of raw sugar". Plot technique is to receive attention on the agricultural side; and we learn there is to be a symposium on the very important subject of selection of useful types in sugarcane breeding. Australia is said to be a land of diseases and the Pathological section—including virus diseases and quarantine—is expected to be particularly instructive. Testing of new varieties for disease resistance and control of diseases by cultural operations are two of the rather attractive items in the programme of the Congress.

The Australian Government and the Sugar Industry are doing their best to render a visit to the Congress both comfortable and instructive. In India there are as many as 28 members of this Society representing the various lines of Sugar Research in the country and the Industry in all its aspects. About half a dozen delegates from India are expected to attend the Brisbane Congress.

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We acknowledge with thanks the receipt of the following :—

"Journal of Agricultural Research," Vol. 50, Nos. 4 and 5.

"Journal of Agriculture and Live-stock in India," Vol. 5, No. 2.

"The Journal of the Royal Society of Arts," Vol. LXXIII, Nos. 4305–08.

"Biochemical Journal," Vol. 29, No. 5, May 1935.

"American Journal of Botany," Vol. 22, No. 5, May 1935.

"The Journal of the Institute of Brewing," Vol. XLI (Vol. XXXII, New Series), No. 6, June 1935.

"Canadian Journal of Research", Vol. 12, No. 5, May 1935.

"Chemical Age," Vol. 32, Nos. 830–833.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 68, No. 6,

"Ceylon Journal of Science,"—

Section A, Vol. XII, Part 1.
" B, Vol. XIX, Part 1.
" C, Vol. V, .
" D, Vol. III, Part 3.
" E, Vol. I, Part 3.
" G, Vol. II, Part 3.

"The Journal of the Indian Chemical Society," Vol. 12, No. 4, April 1935.

"Experimental Station Record," Vol. 72, No. 5, May 1935.

"Journal of Entomology and Zoology," Vol. 27, No. 1.

"Indian Forester," Vol. LXI, Nos. 6 and 7.

"Forschungen und Fortschritte," Vol. 11, Nos. 15–18.

"Indian Forest Records," Vol. 20. Pt. 15.

"Advance Proceedings and Notices of the Asiatic Society of Bengal," Vol. II, No. 3, June 1935.

"National Geographic Society, Stratosphere Series," No. 1.

"Indian Physico-Mathematical Journal," Vol. 6 No. 1, April 1935.

"Monthly Statistics of the Production of Certain Selected Industries of India" (Government of India Publication), No. 10 of 1934–35, January 1935.

" Department of Scientific and Industrial Research : Report of the Chemistry Research Board for the period ended 31st December 1934, with Historical Introduction and Report by the Director of Chemical Research."

"Mitteilungen über Neuerscheinungen und Fortsetzungen " 1935, No. 3.

"Proceedings of the Association of Economic Biologists, Coimbatore," Vol. 2, 1934.

"Acta Phytogeographica Suecica VII. Das ozeanische Element der Strauch-und-Laubflechten-Flora von Skandinavien."

"Mathematics Student," Vol. III, No. 1, March 1935.

"Medico-Surgical Suggestions," Vol. 4, No. 5.

"Scripta Mathematica," Vol. III, No. 2, April 1935.

"Nagpur Agricultural College Magazine," Vol. 9, Nos. 3 and 4.

"Nature," Vol. 135, Nos. 3421–3424.

"The Journal of the Bombay Natural History," Vol. 37, No. 4.

"The Journal of Nutrition," Vol. 9, No. 5.

"The Journal of Chemical Physics," Vol. 3, No. 6, June 1935.

"Journal de Chimie Physique," Vol. 32, No. 5.

"Indian Journal of Physics," Part IV (and "Proceedings of the Indian Association for the Cultivation of Science," Part IV).

"The Indian Trade Journal," Vol. CXVII, Nos. 1512–1515.

Academies and Societies.

Indian Academy of Sciences.

June 1935. SECTION A.—C. V. RAMAN: *On Iridescent Shells. Part III.—Body-Colours and Diffusion-Haloes.*—The paper describes a group of interesting optical phenomena which have their origin in the granular and colloidal structure of nacre and have no analogue in the optics of transparent stratified films. S. RAMA SWAMY: *X-ray Analysis of the Structure of Iridescent Shells.*—There is a significant and close correspondence between the results of the X-ray investigation and the diffraction haloes observed by Sir C. V. Raman. The nacreous layers of all the shells consist of aragonite crystals oriented with their C-axes normal to the surface. G. R. PARANJPE AND P. Y. DESHPANDE: *Dielectric Properties of Some Vegetable Oils.*—Castor, olive, sesame and cocoanut oils both in the pure state and in solutions in benzene have been studied. K. NEELAKANTAM, R. H. RAMACHANDRA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part I.—Cambodia* (Gossypium hirsutum).—The composition of the pigment from the flower petals varies with the variety, locality and with the season. N. B. BHATT: *High Frequency Spectrum of Mercury Vapour.*—In the feeble blue discharge conditions are more favourable for bringing out the spark lines and some higher members of the arc lines both of which are absent in the high excitation spectrum. T. S. WHEELER: *The Electrostatic Potential of a Crystal of the Cuprite type.*—A simple method for the calculation of the potential of cubic crystal lattices has been applied to the calculation of the electrostatic potential of cuprite. R. S. KRISHNAN: *Molecular Clustering in Binary Liquid Mixtures.*—Molecular clusters exist not only at the critical solution temperature but also at temperatures considerably removed from it. S. SASTRY: *On Sums of Powers.* S. CHOWLA: *A Theorem on Sums of Powers with Applications to the Additive Theory of Numbers (III).* K. RANGASWAMI: *The Theory of Normals to a Quadric in Hyperspace.* D. D. KOSAMBI: *Homogeneous Metrics.* B. VENKATESACHAR AND L. SIBAIYA: *Platinum Isotopes and Their Nuclear Spin.*—These results are obtained from an examination of the hyperfine structure of some ten lines in the arc spectrum of platinum.

SECTION B.—N. N. DASTUR, (MISS) R. KARNAD, B. N. SASTRI AND A. VENKATASUBBAN: *Estimation of Urea.*—A simple titrimetric method for the estimation of urea, consisting in the preliminary hydrolysis by urease and subsequent titration of the ammonium carbonate produced by standard alcoholic HCl in presence of acetone, has been described. G. NARASIMHA MURTHY AND V. SUBRAHMANYAN: *Investigations on the Rôle of Organic Matter in Plant Nutrition. Part VII. Economy of Carbon during Decomposition of Cane Molasses in the Swamp Soil.*—A part of the added organic matter passes into the soil sediment and the rest with the supernatant. During the puddling and flooding processes almost the entire quantity of the added organic matter is washed off by the water. S. C. VERMA: *Studies on the Indian Species of the Genus* Echinochasmus, *Part I. and on an Allied New Genus* Episthochasmus.—The presence of a chambered excretory bladder in some Echinostomatid genera is reported for the first time. A new genus *Episthochasmus* is created from a new species of parasitic Echinostomatid from the common dog of Calcutta. The generic diagnosis of the new genus and the new species *E. caninum* is given. G. N. RANGASWAMI AYYANGAR AND KUNHI KRISHNAN NAMBIAR: *Studies in* Dolichos lablab *(Roxb.) and (L.).—The Indian Field and Garden Bean. I.*—The inheritance of the characters of the bean has been studied and reported. B. A. SUNDARA IYENGAR AND V. SUBRAHMANYAN: *Investigations on the Rôle of Organic Matter in Plant Nutrition. Part VIII. Influence of Fermentable Organic Matter on the Transformations of Iron in the Swamp Soil.*—Fairly large quantities of ferrous iron were brought into solution on adding commercial glucose to peaty and laterite soils. The ferrous iron is largely present in combination with the organic acids produced during fermentation. VISHWAMBHAR PURI AND BAHADUR SINGH: *Studies in the Family Amaranthaceæ. I. The Life-History of* Digera arvensis *Forsk.* B. N. SINGH AND K. KUMAR: *The Influence of Partial Pressure of Carbon Dioxide on Photosynthetic Efficiency.*—The nature of the relationship between the supply of carbon dioxide and the rate of assimilation by radish leaves, has been studied. G. S. SIDDAPPA AND V. SUBRAHMANYAN: *Investigations on the Rôle of Organic Matter in Plant Nutrition. Part IX. Oxidation of Organic Matter in the Soil and Plant Assimilation.*—Treatment of soils with minute quantities of chemical oxidisers such as permanganate, hydrogen peroxide or ferric oxide helps to increase the availability of the organic matter of the soil.

Indian Chemical Society.

April 1934. PANCHANAN NEOGI AND *(Late)* GOPAL KRISHNA MUKHERJEE: *A New Method of Preparing Organo-Mercury Compounds of Phenol and Aromatic Amines, Part II.* K. MADHUSUDANAN PANDALAI: *The "Electron Transfer" Theory Applied to the Reactions in the (Photographic) Developing Bath.* MOHAN SINGH: *Studies on Optical Activity and Chemical Constitution. Part I. Optically active Bases and Acids.* P. PARAMESWARAN PILLAY: *On Anacardic Acid, Part I. Anacardic Acid and Tetrahydro-anacardic Acid.* P. PARAMESWARAN PILLAY: *On Anacardic Acid, Part II.—The Construction of Tetrahydro-anacardic Acid.* BASHIR AHMAD, RANCHODJI DAJIBHAI DESAI AND ROBERT FERGUS HUNTER: *The Formation and Stability of Polybromide Derivatives of Heterocyclic Compounds. Part V.—The Bromination of some* 1-*Aryl-imino-3-aryl-4-keto-5-methyltetra-hydrothiazoles and their* 5 : 5-*dimethyl Homologues and some Remarks on the Theory of Single Linkages.* PHULDEO SAHAY VARMA AND K. S. VENKATARAMAN: *Halogenation. Part X.—Preparation of Mixed Halogen Derivatives of Xylenes.* SUSIL KUMAR RAY: *Parachor and Chemical Constitution. Part II.—The Structure of the Triphenylmethane Dyes.* JAGARAJ BEHARI LAL AND SIKHIBUSHAN DUTT: *A Yellow Colouring Matter from the wiid of* Adina cordifolia. *Hook.* JAGARAJ BEHARI LAL AND SIKHIBUSHAN DUTT: *Chemical Examination of* Butea frondosa *Flowers.*—Isolation of a Crystalline Glucoside of Butin. B. K. MENON AND D. H. PEACOCK: *The Rates of Racemisation of Acids of the type* $R_1(R_2)$-*CH. COOH.* K. VENKATA GIRI AND J. G. SHRIKHANDE: *Studies on Salt Activation. Part I.—Influence of Neutral Salts on the Enzyme Hydrolysis of Starch.*

Reviews.

X-RAYS IN THEORY AND EXPERIMENT. By Arthur H. Compton, PH.D., SC.D., LL.D., Nobel Laureate and Dr. Samuel K. Allison. (Macmillan & Co., 1935.) Pp. 828. Price 31*s.* 6*d.*

This is the second and revised edition of Prof. Compton's well-known book *X-Rays and Electrons* first published in 1926. The first edition and a revised reprint of the same were soon sold out. The present revised second edition was announced some two or three years ago but as the senior author remarks in the preface "attempts at revision could not keep pace with the rapid growth of the subject". Prof. Dr. Allison who joined in collaboration is a well-known authority on X-rays, and has taken the primary responsibility for the greater part of the present volume, such as X-rays and crystals, dispersion and absorption and X-ray spectra.

The subject-matter is divided into nine chapters, appendix and index, comprising 828 pages. The first chapter gives a wonderfully clear and concise presentation of X-rays and their properties written by Prof. Compton himself, bringing out the advances in the whole field of X-rays which have been treated in detail in the rest of the chapters. The second chapter deals with the production of X-rays from the point of view of different theories and their experimental verification. The third chapter also written by Prof. Compton is divided into four parts and deals with scattering by independent electrons, interference with scattered X-rays, the corpuscular aspects of X-rays and the wave-mechanical theory of X-ray scattering. Dispersion theory applied to X-rays is dealt in chapter IV and the study of crystal structure in chapter V. Diffraction of X-rays from crystals is dealt in two parts from point of view of perfect crystals and second of imperfect crystals. The phenomena of ionisation, fluorescence, magnetic spectra, absorption and ejection of photo-electrons are treated in chapter VII. The next chapter is on the interpretation of X-ray spectra and includes systematisation, relative intensities as well as good discussions on non-diagram lines, absorption edges and chemical effects. The last chapter is devoted to a discussion of accurate methods of X-ray wave-length measurements and their results. It includes discussions on double spectrometer measurements and focussing X-ray spectrographs. There are 11 appendices dealing with subjects like velocity of wave groups, atomic structure factors, electronic structure of elements and discussions of Ewald's reciprocal vectors which have been found very useful in the study of crystals having non-orthogonal axes.

This much-looked-for book is unique in its importance and indispensable to advanced students in general and research workers in particular. It is with great difficulty that the authors have managed to give a presentation which, while it is not loaded with the great amount of matter that had accumulated, is at the same time thoroughly adequate and convincing. Full credit is given to all workers in the field. In the introductory first chapter, for example, results of Bohr's theory on energy levels etc., are taken and the screening constant is put in as a correction due to the repulsion of other electrons wisely avoiding any derivation of these. The authors remark "other methods of calculating these have been proposed by Sommerfeld, Heisenberg, Schrödinger and others. From the standpoint of the assumptions involved, these recent theories are preferable; but the calculations are more complex and the results are very nearly the same as those reached by Bohr. It is probably safe to say that the Bohr theory offers as satisfactory a *picture* of what happens in the atom when radiation is emitted as can at present be supplied". Further in preference to their own earlier photographs, the authors reproduce only the excellent photographs of Du Mond and Kirkpatrick on the scattering from carbon showing the Compton shift and obtained by the use of their multiple crystal spectrograph. In a note the authors remark "among those who have published experiments showing the type of spectrum described above are:" and a list of about thirty original papers are given.

We are happy to note that the work of Indian workers in the field has received adequate recognition.

One does not like to find fault with a book so masterly written. It is, however, difficult to follow figures 1-25 given on p. 29 to illustrate the Bragg law. The interfering beams are shown parallel to each other, one wonders how they could meet and interfere. The get-up of the book is excellent and typing

errors found here and there in first edition are absent in this edition.

B. DASANNACHARYA.

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THE STRUCTURE AND PROPERTIES OF MATTER. By Herman T. Briscoe. (McGraw-Hill Book Company, Inc., New York and London. First Edition, 1935.) Pp. vii+420. Price 21*s*. net.

The book under review is of great interest to those who wish to learn the fundamentals of the Physics and Chemistry of atoms. The author's aim has been to describe the physical concepts concerning the structure of different forms of matter in relation to their chemical properties. In the first three chapters of the book there is a nice historical review of the growth of the atomic concept from the time of the ancient Greek Philosophers to the time of the discovery of Radioactivity. Then follow chapters on Radioactivity, the Electron, Protons, the atomic nucleus, the determination of nuclear charge, structure of crystals, Octet theory, Bohr's theory, distribution of Electrons about the nucleus, valency and lastly, the new Quantum Mechanics. The author's object throughout has been to treat the subject from the viewpoint of the chemist rather than that of the physicist. It is not, therefore, surprising that the abstruse mathematical steps that are introduced in treatises on the subject have been rigorously avoided, and the final results have been given with their physical and chemical significance. The author has chosen a happy *via media* between a "popular" book and an exhaustive treatise. The chapter on the new Quantum Mechanics gives a very clear account of the recent advances without the introduction of mathematical formulæ, and serves as an excellent introduction to the subject.

The references given in the book are to the standard text-books and treatises on the various aspects of the structure of matter. It should have been much more useful to those who wish to pursue the subject further, if references to the more important original papers had also been incorporated. The Octet theory though mainly of historical interest now, has been given a little too much space. We should have very much welcomed a more detailed treatment of recent topics like Artificial Radioactivity and the Hydrogen Isotope. Almost the whole book is confined to the structure of the atom rather than the molecule. A chapter on the structure of molecules, a subject of supreme interest to Physicists and Chemists alike could have been added with advantage. One feels disappointed to find no mention of Raman Effect and its applications to chemistry.

This book fulfils to a remarkable extent the long-felt need on the part of students of Chemistry of a suitable book which deals with the varied aspects of the structure of matter, not usually available in a single text-book. Though the book is highly useful for the students of the Honours classes, its high price may preclude its use as a text-book.

M. P. V.

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THE DISCOVERY OF SPECIFIC AND LATENT HEATS. By Douglas McKie and Niels H. de V. Heathcote. (Edward Arnold & Co., London, 1935.) Pp. 155 and six plates. Price 6*s*. net.

Nowadays the history of Science is coming to be regarded as important as the history of Kings and Empires and we find that an increasing measure of accurate and painstaking scholarship is being devoted to the subject. The volume before us is a welcome addition to the growing literature on the history of Science and describes an important chapter in the development of Physics. The researches of Black, Irvine and Watt on the one hand and of Krafft, Richmann and Wilcke on the other, are described and their several claims are judiciously appraised. The material has been taken from original sources and the story is told in the investigators' own words as far as possible. Much sympathy and understanding are necessary to penetrate the obscure thought and quaint reasoning employed in the infant stage of the science: the authors have succeeded very well in making these intelligible to the reader. The plates giving portraits of the important personages in this drama enhance the value of the book. Some long current notions are shown to be ill-founded such as the idea that Black designed and used an ice-calorimeter, which is embellished in most text-books by a drawing of the apparatus. We recommend the book warmly to all students of the history of Science.

T. S. S.

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"HAND UND JAHRBUCH DER CHEMISCHEN PHYSIK" unter mitwirkung Zahlreicher Fachgenossen Herausgegeben von A. Eucken Göttingen und K. l. Wolf Keil. Band 9.

Abschnitt I. "Atomspektren" von H. Kuhn, Oxford. Mit 78 Figuren im text. (Akademische Verlags-gesellschaft M. B. H., Leipzig, 1934.) Pp. 265. Price R.M. 26.

Atomic Spectra by H. Kuhn of Oxford forms the first part of Volume 9 of the series appearing under the title *Hand and Year Book of Chemical Physics* published with the co-operation of numerous scientific workers and edited by Eucken of Göttingen and Prof. Wolf of Keil. Dr. Kuhn has developed his subject from four main aspects, namely, the empirical foundations of atomic spectra, the theoretical foundations of atomic spectra, the structure and character of various spectra and lastly, the structure of the individual spectral lines themselves. In Section A the author begins with a brief description of the various spectroscopic instruments employed in the study of visible, ultra-violet and X-ray regions and then passes on to the empirical classification of simple spectra. Section B dealing with the theoretical foundations of the problem has been dealt appropriately enough first with Bohr's theory of atomic spectra and then the corresponding wave mechanical theory. Section C dealing with the structure and character of the various spectra has naturally been considered at some length. Even here the treatment is no doubt complete dealing as it does with subjects like multiplet structure, Zeeman effect, Stark effect, periodic table and X-rays and lastly, the many electronic or complex spectra, but one feels that the whole treatment is too brief. Section D deals with the structure of the individual spectral lines and the natural width and other influences on the spectral lines. Here again we are of the opinion that the author has not given the problem of hyperfine structure of spectral lines the importance that it deserves, it being one of the live problems of the day. Finally, we no doubt agree that this is a fitting companion volume to the series forming the *Hand and Year Book of Chemical Physics*. It would certainly have served a more useful purpose if it had only been enlarged and not condensed into such a small volume. The printing and general get-up of the book comes up to the usual high standard set by the German publications.

B. V. R.

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AN INTRODUCTION TO THE MODERN THEORY OF VALENCY. By J. C. Speakman. (Messrs. Edward Arnold & Co., London, 1935.) Pp. vii+157. Price 4*s*. 6*d*.

Since the discovery of the electron in 1897 by J. J. Thomson and the nuclear atom by Rutherford in 1911, the developments of the last decade have gradually tended to the general acceptance of the electronic theory of valency and no small part of its triumphs is due to the British School of Scientists. It has united under a single self-consistent viewpoint the three pre-existing partial theories of valency for ionising, non-ionising and molecular compounds.

This modest looking volume by one of the workers in the field gives a lucid exposition of the theory. The essential distinction between electrovalency and covalency, the structure of cyanides and isocyanides, the three electron bond of Pauling and a suggestive chapter on elementary wave mechanics, have been clearly and convincingly presented, the lines along which future advance is to be looked for, being also briefly indicated. The author has taken special pains to suggest a definite system regarding symbolization and terminology of the different types of valencies. A few omissions like that of metallic conduction do not detract from the merit of a book of this introductory character. The treatment is simple, elegant and sufficient and no better introduction can be recommended to one, at present, who wishes to acquaint himself with the modern theory of valency.

B. S. R.

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LA SYNTHESE ASYMETRIQUE. By J. P. Mathieu. (Actualités Scientifiqués et Industrielles, No. 209. Hermann et Cie, Paris, 1935.) Pp. 29. Price 8 Fr.

This is a lucid exposition of the present state of the subject of total or absolute asymmetric synthesis. While partial asymmetric synthesis, that is, synthesis under the directing influence of an already active substance has been achieved in a number of cases, the complete asymmetric synthesis without the influence of any living organism or its product has met with varying amounts of success and failure. The best results have been obtained by using circularly polarised light, and the present monograph recounts in a concise manner the methods and principles involved in the choice of this light energy, and ends with a critical examination of both the positive and the negative results obtained. The monograph will be

found to be highly interesting both to the general reader and the specialist.

M. A. G.

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ELEMENTARY SOLID GEOMETRY. By Naik and Bondale. (Arya Bhushan Press, Poona.) Pp. 214. Price Rs. 2–4–0 net.

The book is well adapted for the use of students of the Intermediate classes. Its main features are a copious collection of examples, a nice and interesting chapter on Preliminary Experimental work and a concise set of postulates. A successful attempt has been made to minimise the number of propositions by appending several results as simple deductions at the end of many of them. The book may appeal to a wider circle of readers if a few chapters on Geometrical Perspective Drawing as taught in the First Year Engineering classes are added.

M. VENKATARAMA IYER.

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DICTIONNAIRE DE LA CHIMIE ET DE SES APPLICATIONS. By Clement Duval, Raymonde Duval, and Roger Dolique. With a Preface by H. Luc. (Hermann & Cie, Paris.) Pp. xxxii+747. Price 90 Francs.

This important publication is intended only for readers who have an adequate knowledge of the French language. It is not a French–English dictionary dealing with chemical topics.

The 747 pages of this work are packed with information of such an exceedingly useful character as to entitle it to be included in the usual list of books of ready reference. For instance, under cobalt is listed more than 250 of its compounds, each one of them with the appropriate formula. The organic compounds, including those recently investigated, are listed under the appropriate heads and their accepted nomenclature and formulæ are clearly indicated. Being of the nature of an encyclopædia, the material is arranged in alphabetical order which greatly facilitates the task of reference.

The work under review gives not only a list of compounds but indicates at the same time the meaning and significance of the various operations connected with them in the chemical laboratory and industry. It will undoubtedly serve a useful purpose especially in satisfying the immediate needs of workers who are far away from well-equipped libraries.

K. R. K.

VAN NOSTRANDS' CHEMICAL ANNUAL. A handbook of useful data for analytical, manufacturing and investigating chemists, chemical engineers and students. Edited by Prof. John C. Olsen. Seventh Issue, 1935. Pp. xviii+1029. Price 25*s*.

The seventh issue of this well-known handbook, which has been recently published, will be welcomed by every serious student of Chemistry. Handbooks get rapidly out of date as accurate data accumulate, and therefore need periodic revision. The new edition of the *Chemical Annual* which is being repeatedly improved upon, incorporates a large number of new and useful tables dealing with physical and chemical data and tables giving boiling points, vapour pressures and latent heats of evaporation. The chemical engineers, in particular, will find this handbook invaluable and the well-known author of the "Unit processes and principles of chemical engineering" who has edited this handbook with the help of Dr. B. Whitney Fergusson, as Assistant Editor, and 13 contributors, has spared no pains in bringing out a thoroughly revised and up-to-date handbook.

The publication of handbooks and dictionaries involves a stupendous amount of meticulous care and labour. It is very difficult to review also these publications. Publications which have undergone several editions should be reliable due not only to the fact that they have undergone revision but also because, the chemists, who consult these handbooks, will draw the attention of Editors, in regard to errors in preceding issues and suggest addition of new tables and data. The Editor of *Chemical Annual* has earned the gratitude of a very large community of scientists, who will have numerous occasions to consult the book in the course of their professional work.

A very useful list of the more important books published since 1926 has been included and with the help of the index which serves as a guide to content matter, it is easy enough to locate the pages in which the required data are to be found. The get-up of the book is excellent.

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CHEMISTRY IN COMMERCE. (George Newnes, Ltd., London, 1935.) Vols. III and IV. Pp. 777–1544+iv. Issued in 16 parts of 1/- each.

The four volumes of *Chemistry in Commerce* which were issued in 32 weekly instalments have recently been completed.

One cannot fail to be struck by the encyclopædic information which the volumes comprise and it can be safely said that we have here, a valuable work, copiously illustrated, at comparatively small cost, which the practising chemist will find numerous occasions to consult.

The subjects dealt with are of varied interest. History, Laboratory devices, analytical control in various industries, etc., are all dealt with by authorities who, by virtue of their intensive works experience, have described in precise terms, with numerous illustrations, the relevant details in simple and eminently understandable language. The chapters on bacteriological research (pp. 1161–1166), Pasteur and fermentation industries (pp. 777-778) make excellent reading. Under Chemistry in Stratosphere (p. 1027), a short account of how Professor Piccard carried a small air-conditioning laboratory into the stratosphere, is described. The chapter on Poison Hazards in Industry (pp. 1430-1435), is invaluable to every chemist. Under Accidental Discoveries in industry (pp. 1158-1160), several instances are described where discoveries were made not entirely by design. "In the field of observation chance only favours those who are prepared" (Pasteur, 1854). "Many men who are very clever—much cleverer than discoverers—never originate anything" (Darwin, 1871). These serve to show how luck enters the field of discoveries. The theme of each chapter has been logically developed. Thus in the chapter on High Speed Centrifuges (pp. 1001-1005), we have first a section on some typical applications, then follows an explanation of centrifugal force and finally a section on the care and maintenance of centrifuges. There are also several notes on the care and maintenance of chemical plant, such as autoclaves (p. 1367) and, on the use of synthetic resins for acid-proofing of chemical plant (p. 1157). Of particular interest are the chapters on measurements of high temperature (p. 1397) and on the use of Parr Bomb calorimeter (pp. 1190-1195). The chemistry and pharmacy of vegetable drugs are dealt with in 14 parts and are systematically treated. The pressure control bottle described on p. 1010, the mechanical shaker prepared from an old bicycle wheel (p. 1042) and the filtering apparatus to maintain constant head described on p. 819 and many other highly useful but simple laboratory devices are to be found throughout the text. The examples mentioned here serve to show the variety of features covered by the book.

One wonders why the manufacture of tea and coffee has escaped the attention of the Editors. On p. 1280, under hydrogenation, molebdinum is spelt as molebdinium. No reference is made to honey under foods. The electrodeposition of lac, a process which has been recently developed (*Chemistry and Industry*, 1934, **26**, 882) has not found a mention in the chapter on lac.

The volumes are, undoubtedly, of the highest interest and we expect that they will gain the popularity which they deserve. Every student of chemistry should learn the ramifications of the subject he is studying and books written in such an easy and understandable manner and still conveying such authoritative information on a large variety of topics, are indeed rare.

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THE CARBOHYDRATES. By E. F. Armstrong and K. F. Armstrong. (Longmans, Green & Co., London, 1934.) Pp. vii+252. Price 15*s*.

During the last quarter of a century Armstrongs' monograph "The carbohydrates and glucosides," has been an indispensable volume in the library of every one interested in the chemistry of sugars. The growth of knowledge in this important field of chemistry necessitated the separation of the glucosides, and a separate monograph entitled "Glycosides" by E. F. Armstrong and K. F. Armstrong, appeared in 1931. The publication under review completes the work of revision and the two companion volumes constitute a masterly exposition of a highly intricate subject.

The volume was eagerly awaited for some years past, notably as a result of the great advances on the structural aspects of the carbohydrates due to the work of Professor Haworth and his school at Birmingham. The volume has been thoroughly revised retaining the main features of treatment, which have proved so popular. Thus, attention is confined to natural sugars and their derivatives; glucose is taken as a typical sugar and its properties and reactions considered with particular reference to its biochemical transformations.

Since Fisher's discovery (1893) of the isomeric derivatives of glucose α and β, an enormous volume of work has accumulated on the structure of glucose. Tollen's butylene oxide ring structure was accepted by Fisher.

The discovery of yet a third reactive form, the so-called γ-form by Fisher and Irvine, needed some revision. The remarkable success which attended the work of Haworth, on the structure of the glucose rings, by the well-known methylation method, resulted in giving the amylene oxide structure (1926) to the oxide form of glucose. Conclusive proof has now been adduced to show that the α and β forms are represented by the 1 : 5 Gluco-pyranose structure and the γ-form by the 1 : 4 gluco-furanose structure. The book under review gives a masterly exposition of the structural aspects of the chemistry of sugars.

The present edition dealing with recent work which has resulted in giving some degree of certainty on matters of structure where controversy existed before, will be welcomed by all.

This brief note cannot be concluded without paying a tribute to the authors of the excellent volume. It is very sad to reflect that the demise of the junior author has removed from the field a bright and promising young scientist, thus resulting in an irreparable loss.

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TEXT-BOOK OF BIOLOGY. By E. R. Spratt and A. V. Spratt. (University Tutorial Press Ltd., London.) Price 9*s*. 6*d*.

The study of biology has become more and more a matter of public interest. The Panama canal was as much a victory over the mosquito and those two diseases, yellow fever and malaria, as a feat of engineering skill. The medical student begins his study with a course in biology and medicine is becoming more a question of applied biology and less a mere study of disease. Biological knowledge is found to be more and more indispensable in agriculture and various industries. Civilised society finds biological knowledge to be of great economic and cultural importance. The recognition of the value of biology has led to its being introduced in schools and colleges. Educationists feel that no subject in the school curriculum, except the mother tongue, is of as great a value as biology. And with the introduction of the subject in schools, there has come up a crop of books on biology. Some are of the old general biology type. Some are merely botany and zoology text-books stitched under the same cover. A few, however, are fresh in their treatment, emphasising the point of view of biology, that something is characteristic of *all* living things and that this something is achieved in many different ways. The book under review takes after the traditional method. Function should receive greater emphasis. On this foundation the study of structure should be based. And animal-life and plant-life should form the two dovetailing pieces of one subject. The common forms usually found in books on general biology are dealt with in the greater part of the book. There are some chapters on the physiology of plants and animals. Some account of the ecology of plants and animals is given. A chapter on heredity, variation and evolution is also included. The book may be of use to students who take up biology in the Intermediate Colleges and to medical students.

T. M. S.

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BOTANY PRINCIPLES AND PROBLEMS. By E. W. Sinnott. (McGraw-Hill Book Co., Inc., New York and London.) Third Edition, 1935, pp. xix+525, Price 21*s*. net.

This is a valuable addition to the list of books on Botany for use in Colleges. The book may be divided into two parts. The first few chapters of the earlier part deal with the introductory survey, the history of botany, the cell, the morphology and physiology of the various organs of the plant like the root, leaf and stem. The next two chapters deal with the physiology of metabolism and growth. Then comes an useful and interesting chapter on "Development and Morphogenesis" followed by two chapters on certain aspects of ecology. The special chapters on "Heredity and Variation" and "Plant Evolution" not only provide refreshing changes from the commonly used text-books packed with morphological details but also serve to widen the scope and horizon of the beginner in botany and bring before him the interesting and useful aspects of the subject. A really good book not only catalogues facts but also arouses the interest and curiosity of the student.

In the second part of the book the various groups of the plant kingdom are discussed with the help of a few specific types. It is interesting to note that the vascular plants as a whole have been called Tracheophyta and divided into three broad groups, the Lycopsida, Sphenopsida and Pteropsida. A chapter on primitive vascular plants—Psilophytales has also been rightly included and placed at the beginning of the Tracheophyta. The author opines that the seed-bearing

habit is not the monopoly of the Gymnosperms and Angiosperms which comprised the old group—Spermatophyta. Consequently this term has been discarded altogether.

Reading through the book one however gets an impression that the treatment in the second part of the book has been somewhat rapid. The systematic botany of the Angiosperms may well have been dealt with in greater details and a few families discussed. The Charophyta are better kept as a separate group instead of being wedged in between the Chlorophyceæ and Phæophyceæ; and the number of genera in the Charophyta is certainly not restricted to two as stated on page 379.

The author has within the space at his disposal dealt with the various aspects of botany. The language is clear and direct while the profuse illustrations and excellent get-up of the book leave nothing to be desired. Another valuable feature of this book is the questionnaire at the end of each chapter which not only helps the student to test how much he has assimilated but also helps him to think and to develop gradually the "inquisitive and critical attitude".

A. R. R.

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LES PROBLEMES DE LA RADIOGEOLOGIE. By W. Vernadsky. (Hermann et Cie, Paris, 1935.) 66 pages. Price 15 francs.

This brochure forms number 201 of the series, "Actualités Scientifiques et Industrielles", the geological section of which is published under the direction of M. Lucien Cayeux. The book is based mainly on two lectures delivered by the author at the University of Paris in 1933. In the earlier pages, the author gives a brief résumé of the outstanding contributions to the subject of radio-geology by scientists like Curie, Joly and Strutt. This is followed by a classification of the scope of the subject. The remaining portion of the work is devoted to a discussion of the special problems pertaining to radiogeology, such as the determination of the oldest portions of the earth's crust, calculation of the age of sedimentary rocks, Joly's thermal cycles, thermal heterogeneity of the biosphere, the low temperatures of the ocean, petroliferous beds as fields of radio-chemical phenomena, the migration of uranium lead, the radio-chemical alteration of radio-active minerals, the carbonaceous minerals (tucholite group) discovered in ancient pegmatites, the chemistry of the oldest portions of the earth and the planetary exhalation of helium.

The bibliography is printed in very small type and this is probably the reason for the many typographical errors found in it. The International Table of Radioactive Elements forms a useful appendix to this excellent summary of the subject of radiogeology.

C. S. P.

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INTRODUCTION TO GEOLOGY. By Prof. E. B. Branson and Prof. W. A. Tarr. (McGraw-Hill Book Co., Ltd., New York and London.) Pp. viii+470. 21*s.* net.

"Introduction to Geology" by Profs. Branson and Tarr forms a useful addition to many of the excellent text-books on the subject which have been published in English. In this book the authors have aimed to present the fundamental principles of Geology in a style simple enough to meet the needs of elementary students who require but an intelligent initiation into a study of the subject.

The book is divided into two parts. Part I deals with physical Geology. Starting with an account of the mode of formation of igneous rocks and their constituent minerals, the processes of weathering and rock decay are described followed by the next four chapters on the earth sculpture as brought about by various denuding agencies. Chapters IX and X deal with sedimentary and metamorphic rocks, and are succeeded by two more chapters on the action of snow, ice and wind. The next three chapters XIII to XV give some account of the structural and dynamical geology, the last one being devoted to earthquakes. Part II deals with historical Geology. A concise statement of the views on the origin of the Earth is followed by a narration of the conditions which existed during different geological periods. Descriptions of the plant and animal fossils of the several formations are given and in addition the economic products found in them are also noted. Chapter XX of this part gives an account of the origin, distribution and methods of locating petroleum.

In spite of the limited scope of treatment of the subject one would have liked to see some account of the coral reefs and the importance of corals as rock builders, included in the book. The presentation of the fundamental principles of any branch of science in a simplified style divested with

much of technical phraseology is no simple matter and unless considerable care is exercised in the selections of suitable terms, loose expressions are likely to creep in which would lead to a misconception of statements. The book under review is not entirely free from a few such faults. The terms lava and magma as used by the authors would have been the better for a clearer definition. At the great depths, mentioned by the authors in page 212, pressure is likely to induce rock flowage and not granulation as stated therein.

Substitution of "conjunction" for "connection" in line 37, p. 211; "does" for "is" in line 9, p. 212; "becomes" for "became" in line 6 (reading from the bottom p. 222) would perhaps make the sense clearer.

The phenomena of re-fusion, density stratification of magmas and igneous intrusions by magmatic stoping are still too controversial to be presented to elementary students as well-established facts.

Despite these few slips, the authors have succeeded in achieving their main purpose, and the book will certainly prove to be a welcome addition and appeal to those readers, who require an elementary knowledge of Geology. It is profusely illustrated with well-chosen photographs and drawings and the general get-up of the volume is all that could be desired.

B. R. R.

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THE WORKING, HEAT TREATING AND WELDING OF STEEL. By H. L. Campbell. (Messrs. Chapman & Hall, Ltd., London.) Pp. 185. Price 11*s*. 6*d*.

The above book is a welcome addition to the large number of treatises already available on the subject of Steel Metallurgy, and should serve as an introduction to the study of different aspects of Steel Metallurgy. It is not usual to find in one book references to the manufacturing processes as well as the shaping, treating and testing of different classes of steel. It is from this point of view that the text-book should be recommended not only to students and apprentices who desire to take up the profession of iron and steel manufacture but also to Managers of industrial establishments who desire to have a general knowledge of all phases of Steel Metallurgy.

The first 3 chapters dealing with various methods of manufacturing steel and the basis on which the steels are classified give all information that is necessary in as brief and intelligible a manner as possible for making a beginning of the study. The author's reference to the High Frequency Furnace shows that all the latest developments in the field of steel making have been kept in view. The physical tests of steel which may perhaps have been dealt with later, deal with only the important tests on the basis of which the qualities of different steels are compared.

The effects of temperature changes and mechanical working of steel form a proper prelude to the next chapter giving a very brief account of different kinds of working steel. The development of steel products from ingots, and the equipment for the manufacture of important classes of steel products such as rails, sections, plates, tubes and axles are brought out very clearly without going into great details which would surely confuse the beginner. Cold rolling which has been playing so prominent a part in the production of quality steel products is given its due importance.

The brief description of the physical constituents of steel with suitable microphotographs of the important constituents in steel is necessary for proper understanding of the heat treatment of steel which plays so important a part in the utilisation of the best qualities that are available in steels; and the equipment required for a proper sized heat treatment shop should serve as a valuable guide to the Engineering or Metallurgical student during his first years of apprenticeship.

Only one chapter for alloy steels and their heat treatment seems rather too brief, considering the varieties of alloy steels in common use and their growing importance in all fields of engineering activities. Even in a small text-book such as the one under review one would like to have more information and data about stainless steels, high speed steels and spring steels.

The extensive use of welding in the construction of engineering structures, automobiles, rail-road cars, etc., fully justifies a detailed description of the principle of welding and the different processes which are in vogue. The concluding chapter describing the various processes adopted for the preservation of steel forms a fit ending for this admirable, though brief, text-book. One should have no hesitation in stating that this book should find a prominent place on the tables of all students of engineering and metallurgy.

A reference to the bibliography on the metallurgy of steel given at the end of the book may not be out of place. From a perusal of the list, one is satisfied that he can get any information, however detailed, relating to the practice of steel making, rolling of different steel products, the treatment of different classes of steel, standards accepted for the various classes of steel, and micrographic study of the constituents of steel. One would have, however, liked to see in this list several valuable contributions from well-known Metallurgists on the Continent and in England.

The laboratory assignments given at the end emphasise the scope of the book, namely, its use as a text-book by technical students.

D. V. KRISHNA RAO.

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COFFEE IN 1931 AND 1932.—Economic and Technical Aspects. (International Institute of Agriculture, Rome.) Pp. 229.

This monograph, published under the auspices of the International Institute of Agriculture, Rome, is the first of the series of monographs on important agricultural subjects which the Institute proposes to publish.

A considerable portion of the monograph is devoted to the economics of coffee production, and over-production, no doubt due to the severe depression the coffee trade is struggling under ever since 1929. Over-production seems to be not so much a result of better yields as of increased acreage under coffee. The phenomenon of over-production is possibly only a temporary one, fostered by the boom years prior to 1929, and, therefore, may be expected to be checked by the lean years that have followed since then. Over-production is not, however, the only problem that faces the coffee grower. Other problems of various and varied interest like soil exhaustion, control of insect pests and fungoid diseases, improvement in quality, improved methods of marketing are all becoming increasingly important and clamour for solution.

These and allied problems form the subject-matter of the latter parts of the monograph. An exhaustive review of work on technical and ecological aspects of coffee growing forms an interesting and instructive chapter to both planters and students alike for study and assimilation. Equally of interest is the chapter on diseases and pests of coffee.

The monograph gains value by the inclusion of a short but instructive chapter on the preparation of coffee in its various stages. This attempt is specially welcome in view of the numerous attempts that are being made all the world over to improve the quality of the berry before it comes into the market. That quantity must give place to quality cannot be too often stressed and it is therefore of particular satisfaction that a monograph on coffee should include and emphasise this point for thoughtful consideration.

The value of the monograph as a reference book, which it is intended to be, is enhanced by the inclusion at the end of each chapter of a fairly exhaustive bibliography of the period which it covers.

The book deals with the years 1931 and 1932, a period during which the depression in the coffee trade first began to be felt seriously. The situation has not improved with the passage of time and with the prices at the level that they are gives little hope of improvement in the near future. It is therefore of obvious importance that a pause should be made in the field of competitive production—nay, over-production—and a stock of the situation taken. The book under review does this in an eminently practical manner and more, adds technical information towards a solution of the various problems that beset both the coffee grower and the trader alike. The book may be consulted with advantage not only by the planter but also by the scientist.

B. N. I.

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INDUSTRIAL POSSIBILITIES OF SOME RESEARCH WORK DONE IN INDIA. By Gilbert J. Fowler, D.SC., F.I.C. (Society of Biological Chemists, India, 1934.) Pp. 42. Price Re. 1.

This neat little publication contains the substance of two lectures delivered by the author at Bangalore under the auspices of the Society. It is very welcome just now, when two Research Organisations have recently been established, one by the Government of India and the other by the Government of Mysore for co-ordinating Industrial Research being pursued at different centres at present.

The first part of the brochure deals with "Researches resulting in permanent factories," particular mention being made of The Sandalwood Oil Factory, Mysore, The Whitelead Syndicate, Bangalore, The Government Soap Factory, Bangalore and the Turpentine Distilleries at Clutterbuckganj

and Jallo. Next part dealing with problems which have been investigated and the results of which await commercial exploitation is of greater interest. Manufacture of Glue as a Cottage Industry and as a subsidiary industry in Tanneries is well worth serious consideration by all interested in a self-sufficient India. Utilization of Molasses is the problem of the day, in view of the large number of Sugar Factories (152) recently started and manufacture of cheap power alcohol should become an accomplished fact very soon; actually, the Mysore Sugar Co., Mandya, have already started the manufacture of cheap alcohol from molasses. The section dealing with small industries requiring very little capital is the most important in the opinion of the reviewer, as the starting of such industries is the only possible means of improving the economic condition of the masses.

By drawing attention to a large number of problems of economic importance to India, Dr. Fowler has done a distinct service to the cause of economic reconstruction in this country. One only hopes that the trouble he has taken will to a small extent at least be repaid by organised research on the new problems and accumulation of useful and practical data.

A very adequate bibliography enhances the usefulness of this important brochure considerably.

K. A. N. R.

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REPORT ON THE SALT INDUSTRY OF RAICHUR AND GULBARGA DISTRICTS. By S. R. Bhate, B.A., B.Sc., with notes by L. S. Krishnamurthy, B.Sc., and Captain L. Munn, O.B.E., M.E. (Bulletin No. 11, Department of Commerce and Industries, H. E. H. the Nizam's Government; Industrial Laboratory.) Pp. 154. Price Rs. 2–8–0.

The publication under review discusses in detail all the sources of salt in Hyderabad which may be classed under the two heads: (1) Salt earth and (2) Saline water. The quality of salt at present manufactured as a cottage industry has been investigated by the analysis of a large number of samples from different localities and useful and necessary data have been accumulated.

The relative merits of pan evaporation and stack evaporation of brine have been investigated and as a result of these investigations the author arrives at the very interesting conclusion that "the advantage of stack evaporation (10′ cube) over solar pan evaporation (10′ square) is 22·5 times". It is therefore suggested that stack evaporation should be adopted and would be a distinct aid to this cottage industry. But one might sound a note of caution that more work is probably necessary before this point could be definitely settled.

The Government Industrial Laboratory, Hyderabad, is doing a distinct service to Indian Industry by publishing reports of the investigations conducted there, but, without any intention of striking a discordant note, it may legitimately be asked whether a price of Rs. 2–8–0 for such publications is not far too high in a country like India where the purchasing power of educated classes is so small.

K. A. N. R.

Forthcoming Event.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

September 2nd to 4th, 1935—Meeting of the Governing Council.

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